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The United States Air Force High School Apprenticeship Program's (USAF- HSAP) purpose is to place outstanding high school students whose interests are in the areas of mathematics, engineering, and science to work in a laboratory environment. The students selected to participate in the program work in an Air Force Laboratory for a duration of 8 weeks during their summer vacation.

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UNITED STATES AIR FORCE

SUMMER RESEARCH PROGRAM -- 1994

HIGH SCHOOL APPRENTICESHIP PROGRAM FINAL REPORTS

VOLUME 12B

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Washington, D.C.

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PREFACE

Reports in this volume are numbered consecutively beginning with number 1. Each report is paginated with the report number followed by consecutive page numbers, e.g., 1-1, 1-2, 1-3; 2-1, 2-2, 2-3.

Due to its length, Volume 12 is bound in two parts, 12A and 12B. Volume 12A contains #1-19. Volume 12B contains reports #20-38. The Table of Contents for Volume 12 is included in both parts.

This document is one of a set of 16 volumes describing the 1994 AFOSR Summer Research Program. The following volumes comprise the set:

VOLUME	**TITLE**
1	Program Management Report
	Summer Faculty Research Program (SFRP) Reports
2A & 2B	Armstrong Laboratory
3A & 3B	Phillips Laboratory
4	Rome Laboratory
5A & 5B	Wright Laboratory
6	Arnold Engineering Development Center, Frank J. Seiler Research Laboratory, and Wilford Hall Medical Center
	Graduate Student Research Program (GSRP) Reports
7	Armstrong Laboratory
8	Phillips Laboratory
9	Rome Laboratory
10	Wright Laboratory
11	Arnold Engineering Development Center, Frank J. Seiler Research Laboratory, and Wilford Hall Medical Center
	High School Apprenticeship Program (HSAP) Reports
12A & 12B	Armstrong Laboratory
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1. INTRODUCTION

The Summer Research Program (SRP), sponsored by the Air Force Office of Scientific Research (AFOSR), offers paid opportunities for university faculty, graduate students, and high school students to conduct research in U.S. Air Force research laboratories nationwide during the summer.

Introduced by AFOSR in 1978, this innovative program is based on the concept of teaming academic researchers with Air Force scientists in the same disciplines using laboratory facilities and equipment not often available at associates' institutions.

AFOSR also offers its research associates an opportunity, under the Summer Research Extension Program (SREP), to continue their AFOSR-sponsored research at their home institutions through the award of research grants. In 1994 the maximum amount of each grant was increased from $20,000 to $25,000, and the number of AFOSR-sponsored grants decreased from 75 to 60. A separate annual report is compiled on the SREP.

The Summer Faculty Research Program (SFRP) is open annually to approximately 150 faculty members with at least two years of teaching and/or research experience in accredited U.S. colleges, universities, or technical institutions. SFRP associates must be either U.S. citizens or permanent residents.

The Graduate Student Research Program (GSRP) is open annually to approximately 100 graduate students holding a bachelor's or a master's degree; GSRP associates must be U.S. citizens enrolled full time at an accredited institution.

The High School Apprentice Program (HSAP) annually selects about 125 high school students located within a twenty mile commuting distance of participating Air Force laboratories.

The numbers of projected summer research participants in each of the three categories are usually increased through direct sponsorship by participating laboratories.

AFOSR's SRP has well served its objectives of building critical links between Air Force research laboratories and the academic community, opening avenues of communications and forging new research relationships between Air Force and academic technical experts in areas of national interest; and strengthening the nation's efforts to sustain careers in science and engineering. The success of the SRP can be gauged from its growth from inception (see Table 1) and from the favorable responses the 1994 participants expressed in end-of-tour SRP evaluations (Appendix B).

AFOSR contracts for administration of the SRP by civilian contractors. The contract was first awarded to Research & Development Laboratories (RDL) in September 1990. After completion of the 1990 contract, RDL won the recompetition for the basic year and four 1-year options.

2. PARTICIPATION IN THE SUMMER RESEARCH PROGRAM

The SRP began with faculty associates in 1979; graduate students were added in 1982 and high school students in 1986. The following table shows the number of associates in the program each year.

Table 1: SRP Participation, by Year

YEAR	Number of Participants			TOTAL
	SFRP	GSRP	HSAP	
1979	70			70
1980	87			87
1981	87			87
1982	91	17		108
1983	101	53		154
1984	152	84		236
1985	154	92		246
1986	158	100	42	300
1987	159	101	73	333
1988	153	107	101	361
1989	168	102	103	373
1990	165	121	132	418
1991	170	142	132	444
1992	185	121	159	464
1993	187	117	136	440
1994	192	117	133	442

Beginning in 1993, due to budget cuts, some of the laboratories weren't able to afford to fund as many associates as in previous years; in one case a laboratory did not fund <u>any</u> additional associates. However, the table shows that, overall, the number of participating associates increased this year because two laboratories funded more associates than they had in previous years.

3. RECRUITING AND SELECTION

The SRP is conducted on a nationally advertised and competitive-selection basis. The advertising for faculty and graduate students consisted primarily of the mailing of 8,000 44-page SRP brochures to chairpersons of departments relevant to AFOSR research and to administrators of grants in accredited universities, colleges, and technical institutions. Historically Black Colleges and Universities (HBCUs) and Minority Institutions (MIs) were included. Brochures also went to all participating USAF laboratories, the previous year's participants, and numerous (over 600 annually) individual requesters.

Due to a delay in awarding the new contract, RDL was not able to place advertisements in any of the following publications in which the SRP is normally advertised: *Black Issues in Higher Education, Chemical & Engineering News, IEEE Spectrum* and *Physics Today*.

High school applicants can participate only in laboratories located no more than 20 miles from their residence. Tailored brochures on the HSAP were sent to the head counselors of 180 high schools in the vicinity of participating laboratories, with instructions for publicizing the program in their schools. High school students selected to serve at Wright Laboratory's Armament Directorate (Eglin Air Force Base, Florida) serve eleven weeks as opposed to the eight weeks normally worked by high school students at all other participating laboratories.

Each SFRP or GSRP applicant is given a first, second, and third choice of laboratory. High school students who have more than one laboratory or directorate near their homes are also given first, second, and third choices.

Laboratories make their selections and prioritize their nominees. AFOSR then determines the number to be funded at each laboratory and approves laboratories' selections.

Subsequently, laboratories use their own funds to sponsor additional candidates. Some selectees do not accept the appointment, so alternate candidates are chosen. This multi-step selection procedure results in some candidates being notified of their acceptance after scheduled deadlines. The total applicants and participants for 1994 are shown in this table.

Table 2: 1994 Applicants and Participants

PARTICIPANT CATEGORY	TOTAL APPLICANTS	SELECTEES	DECLINING SELECTEES
SFRP (HBCU/MI)	600 (90)	192 (16)	30 (7)
GSRP (HBCU/MI)	322 (11)	117 (6)	11 (0)
HSAP	562	133	14
TOTAL	1484	442	55

4. SITE VISITS

During June and July of 1994, representatives of both AFOSR/NI and RDL visited each participating laboratory to provide briefings, answer questions, and resolve problems for both laboratory personnel and participants. The objective was to ensure that the SRP would be as constructive as possible for all participants. Both SRP participants and RDL representatives found these visits beneficial. At many of the laboratories, this was the only opportunity for all participants to meet at one time to share their experiences and exchange ideas.

5. HISTORICALLY BLACK COLLEGES AND UNIVERSITIES AND MINORITY INSTITUTIONS (HBCU/MIs)

In previous years, an RDL program representative visited from seven to ten different HBCU/MIs to promote interest in the SRP among the faculty and graduate students. Due to the late contract award date (January 1994) no time was available to visit HBCU/MIs this past year.

In addition to RDL's special recruiting efforts, AFOSR attempts each year to obtain additional funding or use leftover funding from cancellations the past year to fund HBCU/MI associates. This year, seven HBCU/MI SFRPs declined after they were selected. The following table records HBCU/MI participation in this program.

Table 3: SRP HBCU/MI Participation, by Year

YEAR	SFRP		GSRP	
	Applicants	Participants	Applicants	Participants
1985	76	23	15	11
1986	70	18	20	10
1987	82	32	32	10
1988	53	17	23	14
1989	39	15	13	4
1990	43	14	17	3
1991	42	13	8	5
1992	70	13	9	5
1993	60	13	6	2
1994	90	16	11	6

6. SRP FUNDING SOURCES

Funding sources for the 1994 SRP were the AFOSR-provided slots for the basic contract and laboratory funds. Funding sources by category for the 1994 SRP selected participants are shown here.

Table 4: 1994 SRP Associate Funding

FUNDING CATEGORY	SFRP	GSRP	HSAP
AFOSR Basic Allocation Funds	150	98*1	121*2
USAF Laboratory Funds	37	19	12
HBCU/MI By AFOSR (Using Procured Addn'l Funds)	5	0	0
TOTAL	192	117	133

*1 - 100 were selected, but two canceled too late to be replaced.
*2 - 125 were selected, but four canceled too late to be replaced.

7. COMPENSATION FOR PARTICIPANTS

Compensation for SRP participants, per five-day work week, is shown in this table.

Table 5: 1994 SRP Associate Compensation

PARTICIPANT CATEGORY	1991	1992	1993	1994
Faculty Members	$690	$718	$740	$740
Graduate Student (Master's Degree)	$425	$442	$455	$455
Graduate Student (Bachelor's Degree)	$365	$380	$391	$391
High School Student (First Year)	$200	$200	$200	$200
High School Student (Subsequent Years)	$240	$240	$240	$240

APPENDIX A -- PROGRAM STATISTICAL SUMMARY

A. Colleges/Universities Represented

Selected SFRP and GSRP associates represent 158 different colleges, universities, and institutions.

B. States Represented

SFRP -Applicants came from 46 states plus Washington D.C. and Puerto Rico. Selectees represent 40 states.

GSRP - Applicants came from 46 states and Puerto Rico. Selectees represent 34 states.

HSAP - Applicants came from fifteen states. Selectees represent ten states.

C. Academic Disciplines Represented

The academic disciplines of the combined 192 SFRP associates are as follows:

Electrical Engineering	22.4%
Mechanical Engineering	14.0%
Physics: General, Nuclear & Plasma	12.2%
Chemistry & Chemical Engineering	11.2%
Mathematics & Statistics	8.1%
Psychology	7.0%
Computer Science	6.4%
Aerospace & Aeronautical Engineering	4.8%
Engineering Science	2.7%
Biology & Inorganic Chemistry	2.2%
Physics: Electro-Optics & Photonics	2.2%
Communication	1.6%
Industrial & Civil Engineering	1.6%
Physiology	1.1%
Polymer Science	1.1%
Education	0.5%
Pharmaceutics	0.5%
Veterinary Medicine	0.5%
TOTAL	100%

Table A-1. Total Participants

Number of Participants	
SFRP	192
GSRP	117
HSAP	133
TOTAL	442

Table A-2. Degrees Represented

Degrees Represented			
	SFRP	GSRP	TOTAL
Doctoral	189	0	189
Master's	3	47	50
Bachelor's	0	70	70
TOTAL	192	117	309

Table A-3. SFRP Academic Titles

Academic Titles	
Assistant Professor	74
Associate Professor	63
Professor	44
Instructor	5
Chairman	1
Visiting Professor	1
Visiting Assoc. Prof.	1
Research Associate	3
TOTAL	192

Table A-4. Source of Learning About SRP

SOURCE	SFRP		GSRP	
	Applicants	Selectees	Applicants	Selectees
Applied/participated in prior years	26%	37%	10%	13%
Colleague familiar with SRP	19%	17%	12%	12%
Brochure mailed to institution	32%	18%	19%	12%
Contact with Air Force laboratory	15%	24%	9%	12%
Faculty Advisor (GSRPs Only)	--	--	39%	43%
Other source	8%	4%	11%	8%
TOTAL	100%	100%	100%	100%

Table A-5. Ethnic Background of Applicants and Selectees

	SFRP		GSRP		HSAP	
	Applicants	Selectees	Applicants	Selectees	Applicants	Selectees
American Indian or Native Alaskan	0.2%	0%	1%	0%	0.4%	0%
Asian/Pacific Islander	30%	20%	6%	8%	7%	10%
Black	4%	1.5%	3%	3%	7%	2%
Hispanic	3%	1.9%	4%	4.5%	11%	8%
Caucasian	51%	63%	77%	77%	70%	75%
Preferred not to answer	12%	14%	9%	7%	4%	5%
TOTAL	100%	100%	100%	100%	99%	100%

Table A-6. Percentages of Selectees receiving their 1st, 2nd, or 3rd Choices of Directorate

	1st Choice	2nd Choice	3rd Choice	Other Than Their Choice
SFRP	70%	7%	3%	20%
GSRP	76%	2%	2%	20%

APPENDIX B -- SRP EVALUATION RESPONSES

1. OVERVIEW

Evaluations were completed and returned to RDL by four groups at the completion of the SRP. The number of respondents in each group is shown below.

Table B-1. Total SRP Evaluations Received

Evaluation Group	Responses
SFRP & GSRPs	275
HSAPs	116
USAF Laboratory Focal Points	109
USAF Laboratory HSAP Mentors	54

All groups indicate near-unanimous enthusiasm for the SRP experience.

Typical comments from 1994 SRP associates are:

> "[The SRP was an] excellent opportunity to work in state-of-the-art facility with top-notch people."
>
> "[The SRP experience] enabled exposure to interesting scientific application problems; enhancement of knowledge and insight into 'real-world' problems."
>
> "[The SRP] was a great opportunity for resourceful and independent faculty [members] from small colleges to obtain research credentials."
>
> "The laboratory personnel I worked with are tremendous, both personally and scientifically. I cannot emphasize how wonderful they are."
>
> "The one-on-one relationship with my mentor and the hands on research experience improved [my] understanding of physics in addition to improving my library research skills. Very valuable for [both] college and career!"

Typical comments from laboratory focal points and mentors are:

> "This program [AFOSR - SFRP] has been a 'God Send' for us. Ties established with summer faculty have proven invaluable."
>
> "Program was excellent from our perspective. So much was accomplished that new options became viable "
>
> "This program managed to get around most of the red tape and 'BS' associated with most Air Force programs. Good Job!"
>
> "Great program for high school students to be introduced to the research environment. Highly educational for others [at laboratory]."
>
> "This is an excellent program to introduce students to technology and give them a feel for [science/engineering] career fields. I view any return benefit to the government to be 'icing on the cake' and have usually benefitted."

The summarized recommendations for program improvement from both associates and laboratory personnel are listed below (Note: basically the same as in previous years.)

A. Better preparation on the labs' part prior to associates' arrival (i.e., office space, computer assets, clearly defined scope of work).

B. Laboratory sponsor seminar presentations of work conducted by associates, and/or organized social functions for associates to collectively meet and share SRP experiences.

C. Laboratory focal points collectively suggest more AFOSR allocated associate positions, so that more people may share in the experience.

D. Associates collectively suggest higher stipends for SRP associates.

E. Both HSAP Air Force laboratory mentors and associates would like the summer tour extended from the current 8 weeks to either 10 or 11 weeks; the groups state it takes 4-6 weeks just to get high school students up-to-speed on what's going on at laboratory. (Note: this same arguement was used to raise the faculty and graduate student participation time a few years ago.)

2. 1994 USAF LABORATORY FOCAL POINT (LFP) EVALUATION RESPONSES

The summarized results listed below are from the 109 LFP evaluations received.

1. LFP evaluations received and associate preferences:

Table B-2. Air Force LFP Evaluation Responses (By Type)

		How Many Associates Would You Prefer To Get ? (% Response)											
		SFRP				GSRP (w/Univ Professor)				GSRP (w/o Univ Professor)			
Lab	**Evals Recv'd**	**0**	**1**	**2**	**3+**	**0**	**1**	**2**	**3+**	**0**	**1**	**2**	**3+**
AEDC	10	30	50	0	20	50	40	0	10	40	60	0	0
AL	44	34	50	6	9	54	34	12	0	56	31	12	0
FJSRL	3	33	33	33	0	67	33	0	0	33	67	0	0
PL	14	28	43	28	0	57	21	21	0	71	28	0	0
RL	3	33	67	0	0	67	0	33	0	100	0	0	0
WHMC	1	0	0	100	0	0	100	0	0	0	100	0	0
WL	46	15	61	24	0	56	30	13	0	76	17	6	0
Total	121	25%	43%	27%	4%	50%	37%	11%	1%	54%	43%	3%	0%

LFP Evaluation Summary. The summarized repsonses, by laboratory, are listed on the following page. LFPs were asked to rate the following questions on a scale from 1 (below average) to 5 (above average).

2. LFPs involved in SRP associate application evaluation process:
  a. Time available for evaluation of applications:
  b. Adequacy of applications for selection process:
3. Value of orientation trips:
4. Length of research tour:
5 a. Benefits of associate's work to laboratory:
  b. Benefits of associate's work to Air Force:
6. a. Enhancement of research qualifications for LFP and staff:
  b. Enhancement of research qualifications for SFRP associate:
  c. Enhancement of research qualifications for GSRP associate:
7. a. Enhancement of knowledge for LFP and staff:
  b. Enhancement of knowledge for SFRP associate:
  c. Enhancement of knowledge for GSRP associate:
8. Value of Air Force and university links:
9. Potential for future collaboration:
10. a. Your working relationship with SFRP:
  b. Your working relationship with GSRP:
11. Expenditure of your time worthwhile:

(Continued on next page)

12. Quality of program literature for associate:
13. a. Quality of RDL's communications with you:
    b. Quality of RDL's communications with associates:
14. Overall assessment of SRP:

Laboratory Focal Point Reponses to above questions

	AEDC	*AL*	*FJSRL*	*PL*	*RL*	*WHMC*	*WL*
# Evals Recv'd	10	32	3	14	3	1	46
Question #							
2	90 %	62 %	100 %	64 %	100 %	100 %	83 %
2a	**3.5**	**3.5**	4.7	4.4	4.0	4.0	**3.7**
2b	4.0	3.8	4.0	4.3	4.3	4.0	3.9
3	4.2	3.6	4.3	3.8	4.7	4.0	4.0
4	3.8	3.9	4.0	4.2	4.3	NO ENTRY	4.0
5a	4.1	4.4	4.7	4.9	4.3	3.0	4.6
5b	4.0	4.2	4.7	4.7	4.3	3.0	4.5
6a	**3.6**	4.1	**3.7**	4.5	4.3	**3.0**	4.1
6b	3.6	4.0	4.0	4.4	4.7	3.0	4.2
6c	3.3	4.2	4.0	4.5	4.5	3.0	4.2
7a	3.9	4.3	4.0	4.6	4.0	3.0	4.2
7b	4.1	4.3	4.3	4.6	4.7	3.0	4.3
7c	3.3	4.1	4.5	4.5	4.5	5.0	4.3
8	4.2	4.3	5.0	4.9	4.3	5.0	4.7
9	3.8	4.1	4.7	5.0	4.7	5.0	4.6
10a	4.6	4.5	5.0	4.9	4.7	5.0	4.7
10b	4.3	4.2	5.0	4.3	5.0	5.0	4.5
11	4.1	4.5	4.3	4.9	4.7	4.0	4.4
12	4.1	3.9	4.0	4.4	4.7	3.0	4.1
13a	**3.8**	**2.9**	4.0	4.0	4.7	**3.0**	**3.6**
13b	**3.8**	**2.9**	4.0	4.3	4.7	**3.0**	**3.8**
14	4.5	4.4	5.0	4.9	4.7	4.0	4.5

3. 1994 SFRP & GSRP EVALUATION RESPONSES

The summarized results listed below are from the 275 SFRP/GSRP evaluations received.

Associates were asked to rate the following questions on a scale from
1 (below average) to 5 (above average)

1. The match between the laboratories research and your field:		4.6
2. Your working relationship with your LFP:		4.8
3. Enhancement of your academic qualifications:		4.4
4. Enhancement of your research qualifications:		4.5
5. Lab readiness for you: LFP, task, plan:		4.3
6. Lab readiness for you: equipment, supplies, facilities:		4.1
7. Lab resources:		4.3
8. Lab research and administrative support:		4.5
9. Adequacy of brochure and associate handbook:		4.3
10. RDL communications with you:		4.3
11. Overall payment procedures:		3.8
12. Overall assessment of the SRP:		4.7
13. a. Would you apply again?	Yes:	85%
b. Will you continue this or related research?	Yes:	95%
14. Was length of your tour satisfactory?	Yes:	86%
15. Percentage of associates who engaged in:		
a. Seminar presentation:		52%
b. Technical meetings:		32%
c. Social functions:		03%
d. Other		01%

16. Percentage of associates who experienced difficulties in:

a. Finding housing:	12%
b. Check Cashing:	03%

17. Where did you stay during your SRP tour?

a. At Home:	20%
b. With Friend:	06%
c. On Local Economy:	47%
d. Base Quarters:	10%

THIS SECTION FACULTY ONLY:

18. Were graduate students working with you? Yes: 23%

19. Would you bring graduate students next year? Yes: 56%

20. Value of orientation visit:

Essential:	29%
Convenient:	20%
Not Worth Cost:	01%
Not Used:	34%

THIS SECTION GRADUATE STUDENTS ONLY:

21. Who did you work with:

University Professor:	18%
Laboratory Scientist:	54%

4. 1994 USAF LABORATORY HSAP MENTOR EVALUATION RESPONSES

The summarized results listed below are from the 54 mentor evaluations received.

1. Mentor apprentice preferences:

Table B-3. Air Force Mentor Responses

		How Many Apprentices Would You Prefer To Get ?			
		HSAP Apprentices Preferred			
Laboratory	***# Evals Recv'd***	***0***	**1**	**2**	**3+**
AEDC	6	0	100	0	0
AL	17	29	47	6	18
PL	9	22	78	0	0
RL	4	25	75	0	0
WL	18	22	55	17	6
Total	**54**	**20%**	**71%**	**5%**	**5%**

Mentors were asked to rate the following questions on a scale from 1 (below average) to 5 (above average)

2. Mentors involved in SRP apprentice application evaluation process:
    a. Time available for evaluation of applications:
    b. Adequacy of applications for selection process:
3. Laboratory's preparation for apprentice:
4. Mentor's preparation for apprentice:
5. Length of research tour:
6. Benefits of apprentice's work to U.S. Air force:
7. Enhancement of academic qualifications for apprentice:
8. Enhancement of research skills for apprentice:
9. Value of U.S. Air Force/high school links:
10. Mentor's working relationship with apprentice:
11. Expenditure of mentor's time worthwhile:
12. Quality of program literature for apprentice:
13. a. Quality of RDL's communications with mentors:
    b. Quality of RDL's communication with apprentices:
14. Overall assessment of SRP:

	AEDC	***AL***	***PL***	***RL***	***WL***
# Evals Recv'd	**6**	**17**	**9**	**4**	**18**
Question #					
2	100 %	76 %	56 %	75 %	61 %
2a	4.2	4.0	**3.1**	**3.7**	**3.5**
2b	4.0	4.5	4.0	4.0	3.8
3	4.3	**3.8**	**3.9**	**3.8**	**3.8**
4	4.5	**3.7**	**3.4**	4.2	**3.9**
5	**3.5**	4.1	**3.1**	**3.7**	**3.6**
6	4.3	3.9	4.0	4.0	4.2
7	4.0	4.4	4.3	4.2	3.9
8	4.7	4.4	4.4	4.2	4.0
9	4.7	4.2	3.7	4.5	4.0
10	4.7	4.5	4.4	4.5	4.2
11	4.8	4.3	4.0	4.5	4.1
12	4.2	4.1	4.1	4.8	3.4
13a	**3.5**	**3.9**	**3.7**	4.0	**3.1**
13b	4.0	4.1	3.4	4.0	3.5
14	4.3	4.5	3.8	4.5	4.1

5. 1994 HSAP EVALUATION RESPONSES

The summarized results listed below are from the 116 HSAP evaluations received.

HSAP apprentices were asked to rate the following questions on a scale from 1 (below average) to 5 (above average)

1. Match of lab research to you interest:		3.9
2. Apprentices working relationship with their mentor and other lab scientists:		4.6
3. Enhancement of your academic qualifications:		4.4
4. Enhancement of your research qualifications:		4.1
5. Lab readiness for you: mentor, task, work plan		3.7
6. Lab readiness for you: equipment supplies facilities		4.3
7. Lab resources: availability		4.3
8. Lab research and administrative support:		4.4
9. Adequacy of RDL's apprentice handbook and administrative materials:		4.0
10. Responsiveness of RDL's communications:		3.5
11. Overall payment procedures:		3.3
12. Overall assessment of SRP value to you:		4.5
13. Would you apply again next year?	Yes:	88%
14. Was length of SRP tour satisfactory?	Yes:	78%
15. Percentages of apprentices who engaged in:		
a. Seminar presentation:		48%
b. Technical meetings:		23%
c. Social functions:		18%

PERCEPTION OF THE SPOKEN STIMULI IN THE S.C.O.N.E. SYSTEM

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PERCEPTION OF THE SPOKEN STIMULI IN THE S.C.O.N.E. SYSTEM

Damian A. Kemper
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Abstract

It has long since been known that speech perception is made more difficult during the presence of competing background noise. Many Air Force personnel, such as pilots and crew members, work under such conditions; often times resulting in hearing loss. A system was developed at the Armstrong Laboratory Bioacoustics and Biocommunications Division, Wright Patterson AFB in Ohio, called the Speech Communication in Occupational Noise Environment. The system produces actual aircraft noise at the decibel level present in the cockpit and is designed to evaluate a pilot's performance in the cockpit during the presence of competing background noise. The system uses a version of the Modified Rhyme Test in the presence of this competing noise. This investigation is intended to be a pilot study to provide data on how well a normal hearing individual should score on the test and to determine whether or not there is a significant difference between scores with words presented by a female voice versus a male voice. Results from the test show that there is no significant difference between the two stimuli.

PERCEPTION OF THE SPOKEN STIMULI IN THE S.C.O.N.E. SYSTEM

INTRODUCTION

Many military personnel work in high noise environments, such as flight-lines and piloting aircraft. These conditions can have adverse effects on one's hearing and communication abilities. There have been many tests developed in the past with the designated purpose of evaluating speech perception, but none can evaluate a person with his or her actual communication equipment in his or her working environment (i.e., communication headsets, helmets). The Air Force has recently developed a testing system, the Speech Communication in Occupational Noise Environment (SCONE) test, to evaluate the communication abilities of those who work in high noise environments while wearing their own communication equipment.

The SCONE system incorporates a test which uses seven different voice recordings for test stimuli, all stored on audio cards. This test was conducted as a means of finding out which of two voices was most easily understood by a normal hearing population while the noise from an F-15 competed in the background.

BACKGROUND

Speech perception is the ability of sound waves to be transmitted through the ear and received by the brain, where meaning is attached to them (Newby, 1964). Noise, if there is any in the area, has some effect on one's ability to perceive speech no matter how good a person's hearing happens to be. Besides noise, there are other factors which can impair one's speech perception abilities. Such factors include aging, reverberation, and masking. The aging process causes changes in each of two critical areas of hearing impairment - loss in threshold sensitivity and loss in the ability to understand suprathreshold speech (Jerger, 1993). The pattern of loss in threshold sensitivity is well documented. Since Zwaademaker's ground-breaking report several investigators have indicated the extent of the continued loss in pure-tone sensitivity as a function of frequency (Jerger, 1993).

Accompanying changes in the second area, the ability to understand speech, are not as well understood. Gaeth was one of the earliest investigators to describe a disproportionate loss in single-syllable word intelligibility in the aged patient. He coined the expression 'phonemic regression' to describe the phenomenon. Jerger (1993) notes that in retrospect, this is an example of one of the dangers of giving descriptive terms to phenomena before they are well understood. In the light of present knowledge it seems doubtful that the effect involves either 'phonemes' or 'regressive' tendencies. Nevertheless, the observation that elderly patients have more difficulty in word intelligibility tests than younger subjects with comparable sensitivity loss was a pioneering contribution to the study of the aged patient in audiology (Jerger, 1993).

Another factor which can degrade speech perception is reverberation. It has been demonstrated that speech perception for both normal and special populations (i.e., children, elderly individuals, and people with other linguistic backgrounds) is affected by reverberation (Takata & Nabelek, 1990). The effect of reverberation is comparable to that of noise (Lochner and Burger, 1961; Duquesnoy and Plomp, 1980). However, masking by reverberation is more complex than masking by noise. Since reverberation puts even more energy into the original sound, the interfering "additives" exist only when speech is present. Reverberation causes speech sounds to overlap. The acoustic energy of the vowels is prolonged and the consonants are masked, making consonants which follow vowels harder to perceive (Katz, 1985).

One last factor which can cause difficulty in speech perception is masking or background noise. In everyday listening there are numerous occasions when speech intelligibility is degraded due to the presence of background noise (Bronkhorst & Plomp, 1989). It was shown by several investigators that, in such situations, binaural listening has superiority over monaural listening, especially when speech and noise come from different directions (Carhart, 1965; Dirks and Wilson, 1969a; MacKieth and Coles, 1971).

There have been several tests developed which were designed to evaluate a persons hearing under conditions such as those mentioned above. A few are the In-Flight Hearing Test, the CID W-22 Word Test , and the Modified Rhyme Test (MRT).

The concept of an in-flight hearing test has been around since the year 1958, however there was not a standardized version of the test until 1973 (Gasaway, Sutherland, 1973). As its name indicates, this test is administered to the subject during flight and consists of two parts. The first portion of the test is similar to a multiple choice style of test. In this section of the test the pilot is given a sheet with two columns, numbered one through fifty; and each number has three words following it. The evaluator sits in the second seat of the plane and has a sheet with the same lists of words. The evaluator says the words over the intercom and the pilot circles the word he thinks he hears.

The second portion of the test is called the phrase set and in this part the evaluator has a sheet of paper with several short messages on it. The evaluator says one of the phrases and the pilot has only to repeat the phrase, or at least the main part of it, in order to score correctly. The entire test takes about fifteen minutes to administer and should be given under normal flying conditions; which would be a clear sunny sky, a trouble free aircraft, an alert evaluator, and an alert test subject. These are just a few of the controllable variables which are directly related to this test. A few others, which may or may not be controllable, are the weather, how well the evaluator enunciates, and how much the pilot increases the volume. These variables cause the accuracy level of the test to either raise or drop, making it unreliable.

Another test used to evaluate speech perception is the CID W-22 tests (Hirsch, et al, 1952). This test was and is widely used as a clinical and experimental tool in the evaluation of the of the speech discrimination function of the hearing impaired. These tests consist of four different numbered lists (1-4) of fifty words each, with six scramblings for every list (series A-F). They were developed by using subjects with normal hearing. Little information is available about there reliability and equivalency when they are used with a clinical population. Without this tool, however, their usefulness as a research and clinical instrument is limited. For example, when the lists are employed to assess hearing-aid reliability, information about the reliability, the error of measurement, and the equivalency of the lists is necessary before the clinician can assume that obtained differences in discrimination scores represent real differences among various hearing aids (Shore, et al, 1960) (Ross, Huntington,1962).

Finally, there is the Modified Rhyme Test which was developed in 1963 by Arthur House. This test, as revised and recorded by James Kruel et al (1968), is quite different from other discrimination tests frequently used in audiology clinics. It consists of tape recordings of 6 lists of 50 familiar monosyllabic words, each list randomized six times. Each list is recorded with competing background noise. Details regarding presentation are described elsewhere (Elkins, 1971). The lists incorporate one male and two female speakers: six tapes are available, two tapes for each talker, each tape using one of each noise level. The response sheet for each list has fifty word groupings containing six words, five foils (words which are listed along with the correct answer and the test word). The subject marks the word that is heard in each word group. This test is probably the most reliable of its kind; no figures for accuracy or dependability were listed (Stark & Hagness, 1972).

The Modified Rhyme Test was the test of choice for the S.C.O.N.E. system, however it had to be slightly altered to better fit the systems functions. The S.C.O.N.E. was developed at the Bioacoustics and Biocommunications Branch of Armstrong Laboratory for use by Aeromedical Consultation Services, also in Armstrong Laboratory. Dr. Ann Bell, an otolaryngologist, approached the laboratory to assist her group in developing a better mechanism to determine safety of flight for hearing impaired crew members (West, 1993).

The S.C.O.N.E. system is unique in that it will allow the individual to be tested in an environment which simulates what he or she will be exposed to in the cockpit while wearing their own communication equipment. The system consists of a sound booth which has been modified by placing a speaker system in the ceiling. The system is controlled by customized software which allows the examiner to pick from an inventory of recorded aircraft noise environments. For use in the Air Force, the inventory consists of aircraft cockpit noise. Both the sound stimulus and the talkers have been recorded on audio cards in the personal computer which will prevent having to change tapes/compact disks without compromising the sound quality of the signals. This user-friendly system presents, scores, and records all the data (West, 1993). The system also incorporates some interesting features and components to allow ease of operation and yield accurate results. The main part of the system is the modified audiometric booth, where the test subject sits. Located on the ceiling of this booth are thirty small high output speakers which are capable of playing actual aircraft noise at the decibel level present in the cockpit. There are nineteen different types of aircraft noise to choose from, all stored on audio cards located in the personal computer outside the booth. Other components inside the booth include a laptop computer, which is used for selecting answers, and an actual aircraft radio, into which the pilot may plug his communication equipment. During the actual test the PC located outside the booth is in complete control of the system, recording and scoring results as they are given. The operator of the system is responsible for beginning and monitoring the program, and printing the results. The S.C.O.N.E. is also designed to simulate, as much as possible, the actual cockpit environment. Having the test subject perform the normal actions of preparing to fly and wearing the actual flight suit, helmet, and radio add to the simulation. There are some pilots though who prefer to wear ear plugs while they fly; a factor which could ultimately affect the test results. In 1946, Kryter stated that earplugs improve speech intelligibility in higher noise levels. Therefore, since the pilot has become accustomed to wearing plugs, they could also be worn in the S.C.O.N.E. test.

METHOD

Calibration:

Before each testing day began the system had to be calibrated; a task which took less than five minutes. The S.C.O.N.E. system came equipped with its own devices for calibration which include: a sound level meter, a piston phone, a microphone and stand, and a calibration tone programmed on to one of the audio cards in the PC. Calibration consisted of two parts; for the first part, the sound level meter was connected to an outlet on the outside of the booth. Then the microphone was placed inside the booth and inserted into an outlet on the inside; making the two devices indirectly connected. Then the piston phone was placed over the end of the microphone, and the door was closed. The tone that the piston phone plays is approximately 94 dB of noise and this is the number which should register on the sound level meter. For the second part of calibration, the piston phone was taken away but everything else was left in place. The calibration tone which is stored on the PC's audio cards was then projected through the speakers. The point of calibration is to try to match the intensity of the computer's tone to that of the piston phone. Once the system was calibrated, the equipment was disconnected.

Choosing a Program:

Once the system booted up, a test program was chosen. The 'Run' option was first selected from the main menu. Next the subjects name, communication unit number, the type of aircraft noise to play for the test, and which voice to use were entered. Then the names of the principle investigator and the operator are entered. After all this information was entered the test was initiated. Once the test noise started the subject stepped inside the booth and connected his headset to the radio. The first screen which the subject saw on the laptop had the message: 'Adjust volume now.' During the time this screen is on, the computer presents a voice repeatedly counting down from five to one for a period of twenty-five seconds and the subject selects a volume which is comfortable. The next screen which the subject saw was the first screen of the actual test. Displayed on this screen were six words which were phonetically similar. The voice that the subject heard then said: "Number 1, you will mark __________ please." and placed one of the six words in the message. The pilot identified the word he heard by pushing the key which corresponded to the number of the word. The test continued on for forty nine more questions. After the test was complete, the only task which remained was to print the results.

Test Subjects:

The subjects which were used in this investigation consisted of five adult males ages 26 to 51, all from a normal hearing population Each had normal tympanogram and normal pure-tone audiogram results. The type of aircraft noise chosen was the F-15 (113 dB) and each test subject listened to one female and one male voice.

RESULTS

Results from the testing in Figure One showed that four out of five subjects scored slightly better on the test when listening to the male voice. However, when there was a greater percentage correct on the test with the female voice, the score was significantly higher than the male voice.

Subject	Age	M 1	F 1
1	26	90.4	68.8
2	36	80.8	73.6
3	41	20.8	47.2
4	42	76	61.6
5	51	78.4	73.6

Fig 1. Percent correct responses for male (M1) vs. female voice (F1) on the MRT test lists.

A paired T-test (Figure 2) was conducted, comparing the results for the male and female voices. There was no significant difference noted. However, this could have been due to the small test group.

Paired t-test
Hypothesized Difference = 0

	Mean Diff.	DF	t-Value	P-Value
Male 1, Female 1	4.320	4	.525	.6271

Fig 2. T-test results of male voice vs. female voice. Scores show no major difference.

DISCUSSION

The purpose of this test was to determine whether or not test subjects had more difficulty understanding one voice over another. Unfortunately, there were only male test subjects. Had there been some female subjects involved with the testing, there could very well have been results which showed that females better understand female voices; thus balancing the scores between the two voices. By the same token they still could have increased the number of tests in which the male voice was easier to understand.

Though it was not considered as a variable which could effect test results, age did not seem to have any effects on the results of the test. The ages of the test subjects varied from 26 to 51 and in some cases an older subject did better then a younger one. However, if the test group had been much larger and had a wider range of age, some of the effects of age on speech perception which Jerger (1993) identified, might have appeared.

As mentioned earlier in the text, there are a total of seven voices; four male and three female. The reason only two voices were tested instead of the full set was that the software is brand new and the system would lock-up due to the combination of voice and aircraft noise. The software problems will be remedied sometime in the near future along with some other minor design flaws. After those problems have been corrected, the testing can continue on a much larger scale to establish normative data for each of the stimuli.

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A PARADIGM FOR STUDYING MUTUALLY ADVANTAGEOUS TRADE-OFFS IN MULTI-DISCIPLINARY DESIGN TEAMS: A COMPARISON OF EXPERTISE

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Abstract

In the Collaborative Design Technologies Lab, my research was centered around a laboratory experiment named the TRACE (Tradeoffs, Research, and Analysis in Collaborative Ergonomics) study. This study used an experimental paradigm, the design of a automobile navigation system, to observe the strategies of two experts who engaged in the task. These two experts received very disparate perspectives, in order to simulate a multi-disciplinary decision-making process, where contrasting viewpoints and objectives make negotiation necessary. My work involved transcriptions of the resulting conversations and codification of the data points reached. Results were analyzed to evaluate the paradigm itself and to compare the levels of real-world expertise.

A PARADIGM FOR STUDYING MUTUALLY ADVANTAGEOUS TRADE-OFFS IN MULTI-DISCIPLINARY DESIGN TEAMS: A COMPARISON OF EXPERTISE

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Introduction

For the past three years, the Collaborative Design Technologies Laboratory at Armstrong Laboratories has been using a three-fold plan to study Collaborative Design, Design Technology, and Collaborative Technology. This plan includes *naturalistic observations* of real-life design teams, *technology appraisal* to keep track of the new developments in *computer supported collaborative work* (CSCW) and *laboratory experiments* to study separate aspects of design and collaboration. This report is based on the TRACE task, an experimental paradigm devised by the lab to study the strategies used by multi-disciplinary design teams to reach amenable solutions. Most design teams are multi-disciplinary, in that the separate members have different backgrounds and education, and their expertise is represented in different forms. The TRACE task includes: a format where a systematic search can reveal ways around "cross-disciplinary chokepoints", situations where necessary information is overlooked or under-appraised due to a group's disparate perspectives. (Boff, 1987) The intent was to show that system design can be improved if we better understand: how technical data are communicated and assimilated, how mutually advantageous tradeoffs are discovered, and how the managing of design tradeoffs can best be supported. (Brown, et al. 1994). A particular set of experiments compared real-life experts (Air Force personnel) and novices (college students) to examine how their strategies and rates of success differed.

Method

Experimental Paradigm:

The paradigm itself involved the design of an automobile navigation system. This was researched by the CDT Lab, and a realistic set of attributes and options was compiled. These attributes were then placed into 3 categories: Visual Display Hardware, Navigation Location Support, and Driver Input/Output Features. These 3 categories each had 3 attributes, for instance, Visual Display contained Display Resolution, Size, and Colors. Each attribute had 2 possible values, a High and a Low. For example, Display Size could be 10 inches or 8, and there could be 256 or 16 colors available. This yielded 8 (2x2x2) 'configurations' for each of the 3 categories, from which the subjects would have to select. A metric was then devised to give each attribute two values, depending on how useful or how expensive it was. (see Figure 1) These values were then totaled to give a 'category value'. The arrangement was such as to limit

Human Factors Expert's Perspective

Visual Display Hardware

Display Configuration	Display Resolution	Display Size	Display Colors	Performance Units Gained
1	Medium	8 inch	16 colors	0 PIU
2	Medium	8 inch	256 colors	100 PIU
3	Medium	10 inch	16 colors	200 PIU
4	Medium	10 inch	256 colors	300 PIU
5	High	8 inch	16 colors	400 PIU
6	High	8 inch	256 colors	500 PIU
7	High	10 inch	16 colors	600 PIU
8	High	10 inch	256 colors	700 PIU

PIU = performance improvement units

Navigation Location Support

Navigation Configuration	Antennae Coverage	Error-checking Capability	Level of Database Detail	Performance Units Gained
1	Moderate	Normal	Standard	0 PIU
2	Moderate	Normal	Extended	150 PIU
3	Moderate	Enhanced	Standard	300 PIU
4	Moderate	Enhanced	Extended	450 PIU
5	High	Normal	Standard	600 PIU
6	High	Normal	Extended	750 PIU
7	High	Enhanced	Standard	900 PIU
8	High	Enhanced	Extended	1050 PIU

PIU = performance improvement units

Driver Input/Output Features

Input/Output Configuration	User Output Format	User Input Format	Navigational Map Display	Performance Units Gained
1	Text/Graphic	Text Input	Track-Up Only	0 PIU
2	Text/Graphic	Text Input	Plus North-Up	250 PIU
3	Text/Graphic	Plus Menu	Track-Up Only	500 PIU
4	Text/Graphic	Plus Menu	Plus North-Up	750 PIU
5	Plus Voice	Text Input	Track-Up Only	1000 PIU
6	Plus Voice	Text Input	Plus North-Up	1250 PIU
7	Plus Voice	Plus Menu	Track-Up Only	1500 PIU
8	Plus Voice	Plus Menu	Plus North-Up	1750 PIU

PIU = performance improvement units

Program Manager's Perspective

Visual Display Hardware

Display Configuration	Display Resolution	Display Size	Display Colors	Dollars Saved
1	Medium	8 inch	16 colors	$1750
2	Medium	8 inch	256 colors	$1500
3	Medium	10 inch	16 colors	$1250
4	Medium	10 inch	256 colors	$1000
5	High	8 inch	16 colors	$750
6	High	8 inch	256 colors	$500
7	High	10 inch	16 colors	$250
8	High	10 inch	256 colors	$0

Navigation Location Support

Navigation Configuration	Antennae Coverage	Error-checking Capability	Level of Database Detail	Dollars Saved
1	Moderate	Normal	Standard	$1050
2	Moderate	Normal	Extended	$900
3	Moderate	Enhanced	Standard	$750
4	Moderate	Enhanced	Extended	$600
5	High	Normal	Standard	$450
6	High	Normal	Extended	$300
7	High	Enhanced	Standard	$150
8	High	Enhanced	Extended	$0

Driver Input/Output Features

Input/Output Configuration	User Output Format	User Input Format	Navigational Map Display	Dollars Saved
1	Text/Graphic	Text Input	Track-Up Only	$700
2	Text/Graphic	Text Input	Plus North-Up	$600
3	Text/Graphic	Plus Menu	Track-Up Only	$500
4	Text/Graphic	Plus Menu	Plus North-Up	$400
5	Plus Voice	Text Input	Track-Up Only	$300
6	Plus Voice	Text Input	Plus North-Up	$200
7	Plus Voice	Plus Menu	Track-Up Only	$100
8	Plus Voice	Plus Menu	Plus North-Up	$0

Figure 1. Design configuration data tables for automobile navigation system

the options for a successful solution, in order to force the subjects to negotiate. The two roles were put necessarily at odds, as each increase in performance had a loss in savings, as well. This was felt to be accurate and true to natural situations. Information was then arranged into two separate tables, one with information on how each attribute increased performance (The Human Factors role), and the other with information concerning how much each new attribute would cost (The Program Manager role). The two role-players thus would have expertise on their field alone when the task began: The Human Factors expert was given the performance information and instructed to increase performance at least above a specific level, and be concerned for the customer's welfare. The Program Manager had access only to the information concerning costs, and was instructed to increase savings above a certain minimum level. The two subjects would not know anything of the other's information, except for what the other could communicate. In the experimental set I studied, both players had a goal of 2000 units, either dollars or Performance Improvement Units (PIUs).

Subjects:

The subjects totaled 44 individuals, divided into two groups: 22 experts, working professionals from the Aeronautical Systems Center and Human Engineering Division of Armstrong Laboratory at Wright-Patterson Air Force Base; and 22 novices, students from a small midwestern university. These groups were each then divided into 11 dyads, with one subject becoming that dyad's Program Manager, and the other the Human Factors expert. With the novices, the choice was random as to which role they were assigned. For the experts, the role assigned was based on that subject's prior work experience. The 11 Human Factors experts had human factors/psychology experience averaging 7.6 years, and the 11 Program Managers had managerial experience averaging 12.6 years.

Apparatus and Setup:

The setting itself was a conference room in either Armstrong Laboratories (experts) or in a college classroom building (novices). The subjects were seated facing each other across a table where a divider showed them their data, and prevented them from seeing the other's data. Each subject was given paper and pencils, and a "Contract Agreement" was placed on the table between them to be used to record the final decision. Two video cameras were stationed in the room, one each overlooking the subjects' shoulders, to give a view of the subject seated opposite of them. These video images were then merged into two windows on one screen, giving a recording of both subjects simultaneously. To transcribe the resulting conversations, I used a VCR/TV unit to replay the tapes, and then recorded the spoken and non-verbal discussion. I employed the MacSHAPA (Sanderson, 1993) program to segregate the individual speakers, and then used the resulting printed transcriptions to code data points and evaluate the individual dyads[1].

Experimental Design:

The independent variable was the level of expertise (i.e. expert or novice). The dependent measure of success was the combined 'total outcome' of PIUs gained and dollars saved, which had a possible range of 2,450 to 4,550 in 150 point increments. This measure was used as an index in determining the quality of design agreement. The higher the joint outcome was, the more successful the dyad was deemed, the lower the joint outcome, the less successful and less advantageous the solution. Teams that failed to reach any agreement were assigned a value 150 points below the lowest joint outcome obtained. For simplicity, the results were also divided into two categories, 'good' and 'bad' for simplicity. "Good" results were solutions that met both subjects' goals. "Bad" solutions included failure and all 'agreements' that failed to reach one or the other subject's goal. (or both)

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[1]Data sheets for this encoding devised by C. Brown and R.Whitaker, CDT Lab, Wright-Patterson AFB, OH

Procedure

Subjects were first given instructions specific to their roles (PM or HF information, roles, and goal amounts). Subjects were then instructed that they could share this information with the other role-player, if it was done verbally. Neither was allowed to show their data table to the other. Emphasis was placed on reaching agreement and coming to a satisfactory solution. The subjects were then taken separately into the conference room, and instructed that they would have 15 minutes to complete the task, and if agreement could not be reached in that time period, they would then be given an additional 5 minutes to complete the task. At the end of the 15 minutes, they were then warned that only 5 minutes remained, and if at the end of those 5 minutes, an agreement was not made, the experiment would fail. The experiment ended when the subjects reached agreement and stopped, or after the 20 minutes were finished; the subjects were then told the experiment had failed. The video tapes of all 22 runs (11 expert dyads and 11 novice dyads) were then compiled and transcribed using MacShapa. The transcripts were then examined to code specific landmarks, data points, and strategies employed by the dyads. This data was then compiled and reviewed. (see Figures 2,3,4)

Results

In the study, actual (agreed) joint outcomes ranged from 3050 to 4550, a "perfect" score. Dyads which failed to reach agreement were then assigned a score of 2900 (150 units below the lowest agreed outcome). The original hypothesis was that expert dyads would fare better in the task due to prior expertise. This would seem to be true. expert dyads had significantly higher joint outcomes (average=4100 pts.) than did novices (average=3500). Three expert dyads achieved "perfect" scores (4550), but no novice dyads reached this level; only 2 expert dyads failed to reach agreement (2900), while 4 novice dyads failed. The study of the separate strategies employed also supports the idea that expertise was helpful. Of the "Good" dyads, the experts had 8 which qualified, while the novices only had 4 (leaving 3:7 in the "Bad" category). Comparing the experts vs. novices as a whole, experts shared an average of 17.4 pieces of information (specific values, relationships, or goals) during the experiment, while novice dyads only averaged 7.6 items. However, when comparing information exchange between "Good" and "Bad" categories, I found that, seemingly, more information aided experts, while it <u>hindered</u> novices. "Good" experts averaged 24 pieces, while "Bad" experts used barely 1 per dyad. Good novices averaged 2.5 pieces, but bad novices had an average of 10.6 pieces of information each. A fairly stable 54.5% of all dyads used some sort of distributive strategy, demanding that a certain attribute be included or excluded. Approximately 2 proposals (heuristic trial-and-error) was the average in all dyads, but the level went randomly low and high, with no proposals for some groups and up to 10 for one dyad.

Human Factors Expert

Goal = 2000 pius

Least (self) most (other) — **Visual Display Hardware** — Increment = 100 pius

Display Configuration	Display Resolution	Display Size	Display Colors	Performance Units Gained
1	Medium	8 inch	16 colors	0 piu MIN
2	Medium	8 inch	256 colors	100 piu
3	Medium	10 inch	16 colors	200 piu
4	Medium	10 inch	256 colors	300 piu
5	High	8 inch	16 colors	400 piu
6	High	8 inch	256 colors	500 piu
7	High	10 inch	16 colors	600 piu
8	High	10 inch	256 colors	700 piu MAX
	most (s) most (o) 400piu	200piu	least (s) least (o) 100piu	

Navigation Location Support — Increment = 150 pius

Navigation Configuration	Antennae Coverage	Error-checking Capability	Level of Database Detail	Performance Units Gained
1	Moderate	Normal	Standard	0 piu MIN
2	Moderate	Normal	Extended	150 piu
3	Moderate	Enhanced	Standard	300 piu
4	Moderate	Enhanced	Extended	450 piu
5	High	Normal	Standard	600 piu
6	High	Normal	Extended	750 piu
7	High	Enhanced	Standard	900 piu
8	High	Enhanced	Extended	1050 piu MAX
	most (s) most (o) 600piu	300piu	least (s) least (o) 150piu	

Most (self) least (other) — **Driver Input/Output Features** — Increment = 250 pius

Input/Output Configuration	User Output Format	User Input Format	Navigational Map Display	Performance Units Gained
1	Text/Graphic	Text Input	Track-Up Only	0 piu MAX
2	Text/Graphic	Text Input	Plus North-Up	250 piu
3	Text/Graphic	Plus Menu	Track-Up Only	500 piu
4	Text/Graphic	Plus Menu	Plus North-Up	750 piu
5	Plus Voice	Text Input	Track-Up Only	1000 piu
6	Plus Voice	Text Input	Plus North-Up	1250 piu
7	Plus Voice	Plus Menu	Track-Up Only	1500 piu
8	Plus Voice	Plus Menu	Plus North-Up	1750 piu MIN
	most (s) most (o) 1000piu	500piu	least (s) least (o) 250piu	

Figure 2-Checklist for HF information exchanged

Program Manager

Goal = $2000

Most (self) / least (other) — **Visual Display Hardware** — Increment = $250

Display Configuration	Display Resolution	Display Size	Display Colors	Dollars Saved
1	Medium	8 inch	16 colors	$1750 MAX
2	Medium	8 inch	256 colors	$1500
3	Medium	10 inch	16 colors	$1250
4	Medium	10 inch	256 colors	$1000
5	High	8 inch	16 colors	$750
6	High $1000	8 inch	256 colors	$500
7	High	10 inch $500	16 colors $250	$250
8	High	10 inch	256 colors	$0 MIN

most (s) most (o) — least (s) least (o)

Navigation Location Support — Increment = $150

Navigation Configuration	Antennae Coverage	Error-checking Capability	Level of Database Detail	Dollars Saved
1	Moderate	Normal	Standard	$1050 MAX
2	Moderate	Normal	Extended	$900
3	Moderate	Enhanced	Standard	$750
4	Moderate	Enhanced	Extended	$600
5	High	Normal	Standard	$450
6	High $600	Normal	Extended	$300
7	High	Enhanced $300	Standard $150	$150
8	High	Enhanced	Extended	$0 MIN

most (s) most (o) — least (s) least (o)

Least (self) / most (other) — **Driver Input/Output Features** — Increment = $100

Input/Output Configuration	User Output Format	User Input Format	Navigational Map Display	Dollars Saved
1	Text/Graphic	Text Input	Track-Up Only	$700 MAX
2	Text/Graphic	Text Input	Plus North-Up	$600
3	Text/Graphic	Plus Menu	Track-Up Only	$500
4	Text/Graphic	Plus Menu	Plus North-Up	$400
5	Plus Voice	Text Input	Track-Up Only	$300
6	Plus Voice $400	Text Input	Plus North-Up	$200
7	Plus Voice	Plus Menu $200	Track-Up Only $100	$100
8	Plus Voice	Plus Menu	Plus North-Up	$0 MIN

most (s) most (o) — least (s) least (o)

Figure 3- Checksheet for PM information exchanged

GENERAL POINTS:

•Did they realize that they could reveal specific information from their respective tables?

•Did the PROGRAM MANAGER quote information revealed by the HF EXPERT?
GOAL
TABLE INFO
CATEGORY PRIORITIES

•Did the HF EXPERT quote information revealed by the PROGRAM MANAGER?
GOAL
TABLE INFO
CATEGORY PRIORITIES

•Did one or the other state specific attributes (e.g. Error-Checking) as necessary (implied rigidness) to include or exclude?
PROGRAM MANAGER?
HF EXPERT?

•How many distinct *complete* proposals (i.e. a configuration covering all 3 categories) were put "on the table"?
PROGRAM MANAGER?
HF EXPERT?

•How many times did they tally the outcome of proposed/intermediate solutions (not counting final solutions)?
PROGRAM MANAGER?
HF EXPERT?

- -

Figure 4: Checksheet for General Negotiation Strategies

Comparisons of Expert/Student and Good/Bad Dyads in TRACE Study
(Good= Reached Agreement, Met Goals. Bad= Failed or Did not meet Goals)

Of 11 Expert Dyads:

- 8 were "Good" (3 had a total of 4550 points, 3 had 4400, 1 had 4250, 1 had 4100)
  - 4 of these held some Attribute as Necessary (50%)
  - 20 proposals (total) were offered. (average of 2.5 each dyad)
  - 45 tallies of proposals ocurred (average of 5.6125 each dyad)
  - Total items of information shared: 192 (average of 24 items each dyad)
  - All 8 groups realized they could share information
- 3 were "Bad" (1 had a total of 4100 points, 2 Failed to reach agreement)
  - 2 of these held some Attribute as Necessary (66.66%)
  - 1 proposal (total) was offered. (average of .33 each dyad)
  - 3 tallies of proposals ocurred (average of 1 each dyad)
  - Total items of information shared: 2 (average of .66 items each dyad)
  - No groups realized they could share information
- Totals:
  - 6 of these held some Attribute as Necessary (54.5%)
  - 21 proposals (total) were offered. (average of 1.98 each dyad)
  - 48 tallies of proposals ocurred (average of 4.36 each dyad)
  - Total items of information shared: 194 (average of 17.36 items each dyad)
  - 8 groups realized they could share information (72.73%)

Of 11 Student Dyads:

- 4 were "Good" (2 had a total of 4250 points, 2 had 4100)
  - 2 of these held some Attribute as Necessary (50%)
  - 11 proposals (total) were offered. (average of 2.75 each dyad)
  - 13 tallies of proposals ocurred (average of 3.25 each dyad)
  - Total items of information shared: 10 (average of 2.5 items each dyad)
  - No groups realized they could share information.
- 7 were "Bad" (1 had a total of 3650 points, 1 had 3600, 1 had 3050, and 4 Failed)
  - 4 of these held some Attribute as Necessary (57%)
  - 14 proposals (total) were offered. (average of 2 each dyad)
  - 44 tallies of proposals ocurred (average of 6.28 each dyad)
  - Total items of information shared: 74 (average of 10.56 items each dyad)
  - 4 groups realized they could share information.
- Totals:
  - 6 of these held some Attribute as Necessary (54.5%)
  - 25 proposals (total) were offered. (average of 2.27 each dyad)
  - 57 tallies of proposals ocurred (average of 5.18 each dyad)
  - Total items of information shared: 84 (average of 7.64 items each dyad)
  - 4 groups realized they could share information (36.36%)

Overall: 12 Groups were "Good" and 10 groups were "Bad" (6:5)
  - 12 groups held some attribute as necessary (54.54%)
  - 46 proposals were offered (2.09ea.)/ 105 tallies were made (ea.)
  - Total information shared: 278 items (12.63 ea.)/ 12 groups shared (54.5%)

Discussion

Clearly, then, expertise affects success in finding mutually advantageous solutions to complex problems, but it is not completely clear exactly how it helps. Certainly, Experts had a better average success rate, and better joint outcomes in the mean, but they were no more and no less argumentative (distributive) or trial-and-error oriented (heuristic). Pruitt and Lewis (1975) mention that an information-exchange approach aids bargainers who have high cognitive complexity . This data tends to uphold that supposition. When novices were confronted with more information, they had lower joint outcomes, possibly due to frustration, or as in one case, simply giving up. When experts realize that they can share information, it becomes a vehicle for better solutions. The experimental paradigm itself was deemed satisfactory for testing further comparisons in mutually-advantageous tradeoffs and multi-disciplinary design, but may undergo further refinement to sharpen its focus.

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THE PROCESS OF DISTINGUISHING BETWEEN EGGS
OF *AEDES ALBOPICTUS* AND *AEDES AEGYPTI*

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Final Report For:
High School Apprentice Program
Armstrong Laboratory

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Bolling Air Force Base, DC
and
Armstrong Laboratory

August 1994

THE PROCESS OF DISTINGUISHING BETWEEN EGGS
OF *AEDES ALBOPICTUS* AND *AEDES AEGYPTI*

Trang D. Le
Brackenridge High School

Abstract

Lackland Air Force Base, TX conducted a surveillance program to monitor the populations of *Aedes* mosquitoes. At Brooks Air Force Base, TX tentative identifications were made by examining egg morphology. Specimens were reared to the adult stage for definite identifications. It was determined that Lackland AFB had an infestation of *Aedes albopictus* mosquitoes.

THE PROCESS OF DISTINGUISHING BETWEEN EGGS OF *AEDES ALBOPICTUS* AND *AEDES AEGYPTI*

Trang D. Le

Introduction

During the summer months arthropod-related problems are at their peak. Because of their medical and pest importance, most United States Air Force installations have mosquito surveillance and control programs. *Aedes albopictus, Aedes aegypti,* and *Aedes triseriatus* are among the most common mosquitoes seen during this summer season. *Aedes albopictus* and *Aedes aegypti* are potential vectors of Dengue and yellow fever. In addition, *Aedes albopictus*, a species recently introduced in the U.S., is a potential vector of eastern equine encephalitis (EEE) virus. The Entomology Function at Brooks Air Force Base assists these bases by serving as a diagnostic laboratory for mosquito identification.

Discussion of Problem

Mosquitoes may be identified in the egg, larval, pupal, or adult stage. Because they are day-flying mosquitoes and are not attracted to light traps, *Aedes albopictus* and *Aedes aegypti* are collected using ovipaddles. Ovipaddles are regular brown paper towels wrapped around tongue depressors and securely stapled on each end. These ovipaddles are placed vertically in black plastic cups which are half-filled with water. This instrument, known as an ovitrap, provides an ideal environment for female mosquitoes of *Aedes albopictus* and *Aedes aegypti* to lay their eggs. Females deposit eggs on the paper toweling just above the water line. Because the eggs of these two species are identical, eggs must be hatched and specimens reared to the adult stage for specific identification.

Methodology

Nine ovipaddles were collected on Lackland AFB on May 20, 1994 and submitted to the Medical Entomology Function at Brooks AFB. Of the nine ovipaddles, those from sites 2 and 4 did not contain any eggs. The rest had at least one egg. It was determined that the eggs were *Aedes* (*Stegomia*), but a specific identification could not be made (Table 1). If eggs were present on the ovipaddle, the section of the paper which contained eggs was removed, placed in a 50 mL cup, and covered to dry. After a period of about five days during which time the eggs embryonated and the paper gradually dried, the eggs were flooded with a 1:1 mixture of tap and de ionized water. Bovine liver powder was added to each cup for food.

After hatching, the larvae went through a period of four growth stages called instars. After the fourth larval stage a pupa was formed (Fig. 1). As a pupa, metamorphosis from larvae to adult occurred. Pupation is an indication of impending adult emergence. Cups with pupae were placed inside a quart-sized container covered with cheese cloth. After approximately three days, the adults emerged from their pupal case. From egg to adult, development occurred within two weeks. When it seemed that all the adults emerged, they were anesthetized by being exposed to carbon dioxide. They were then moved from the container into a petri dish and placed in a freezer.

Finally, the mosquitoes were identified by examining the external anatomy of the insect. *Aedes albopictus* and *Aedes aegypti* have contrasting appearances as adults which makes identification simpler than examining their eggs. The most distinctive characteristic appears on the dorsum of the thorax. *Aedes aegypti* has a lyre-shaped pattern formed by silver-white scales (Fig. 2). *Aedes albopictus*, on the other hand, has a single silver-white line down the middle of the thorax (Fig. 3).

Results

The identity of mosquitoes collected on May 20, 1994, from Lackland Air Force Base are summarized in Table 2. Sites 2 and 4 had no eggs. The only egg on the site 7 ovipaddle did not hatch. Adults reared from sites 1, 3, 5, 6, and 10 were all *Aedes albopictus.* Site 9 had a combination of both species. Of 27 eggs, two were *Aedes aegypti* and twenty-five were *Aedes albopictus* (Table 2).

Conclusion

Based on these rearing results, *Aedes albopictus* appears to be the most prevalent mosquito at Lackland Air Force Base. Lackland should continue to monitor and control this medically-important insect. Moreover, the population of *Aedes aegypti* should also be monitored, even though its numbers are relatively insignificant at this time.

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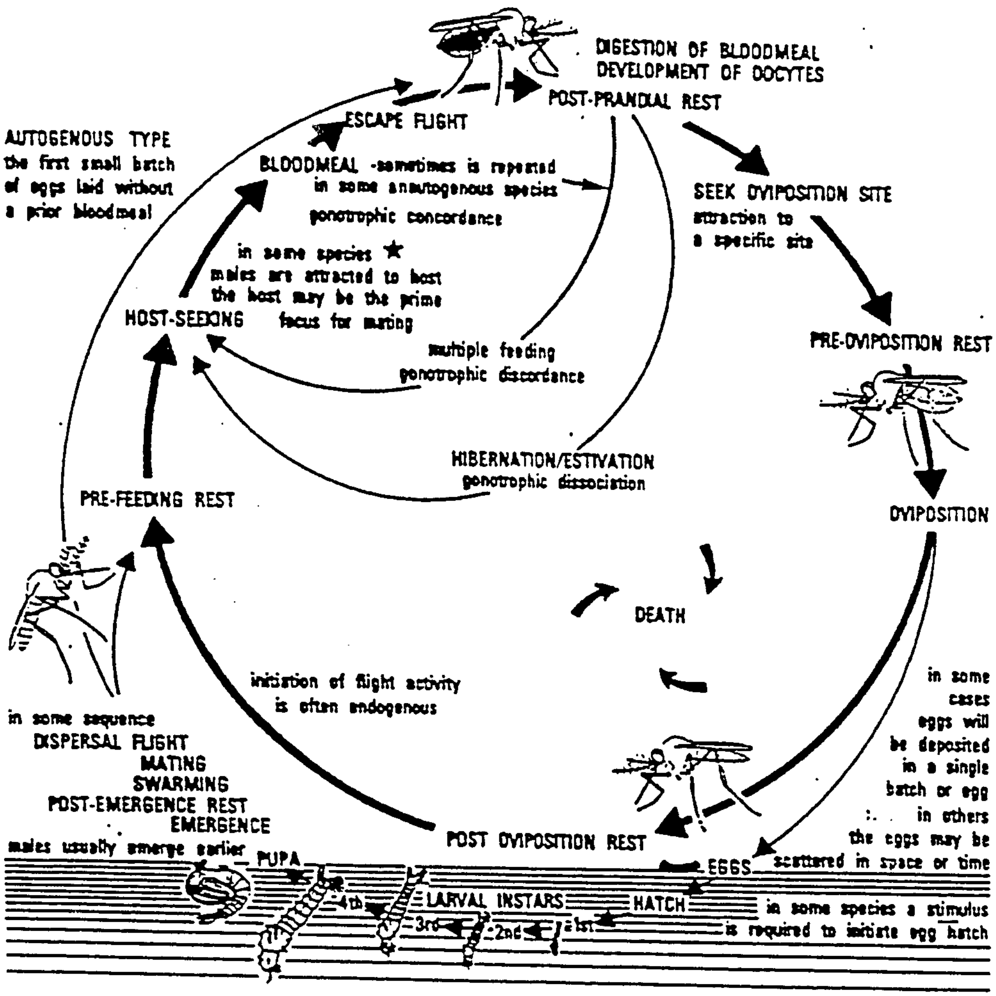

Figure 1-- The mosquito life cycle and gonotrophic cycle. (McClelland G. A. H. *Medical Entolmology: An Ecological Perspective.* 12th ed. Davis: University of California-Davis, 1992. pp. 68.)

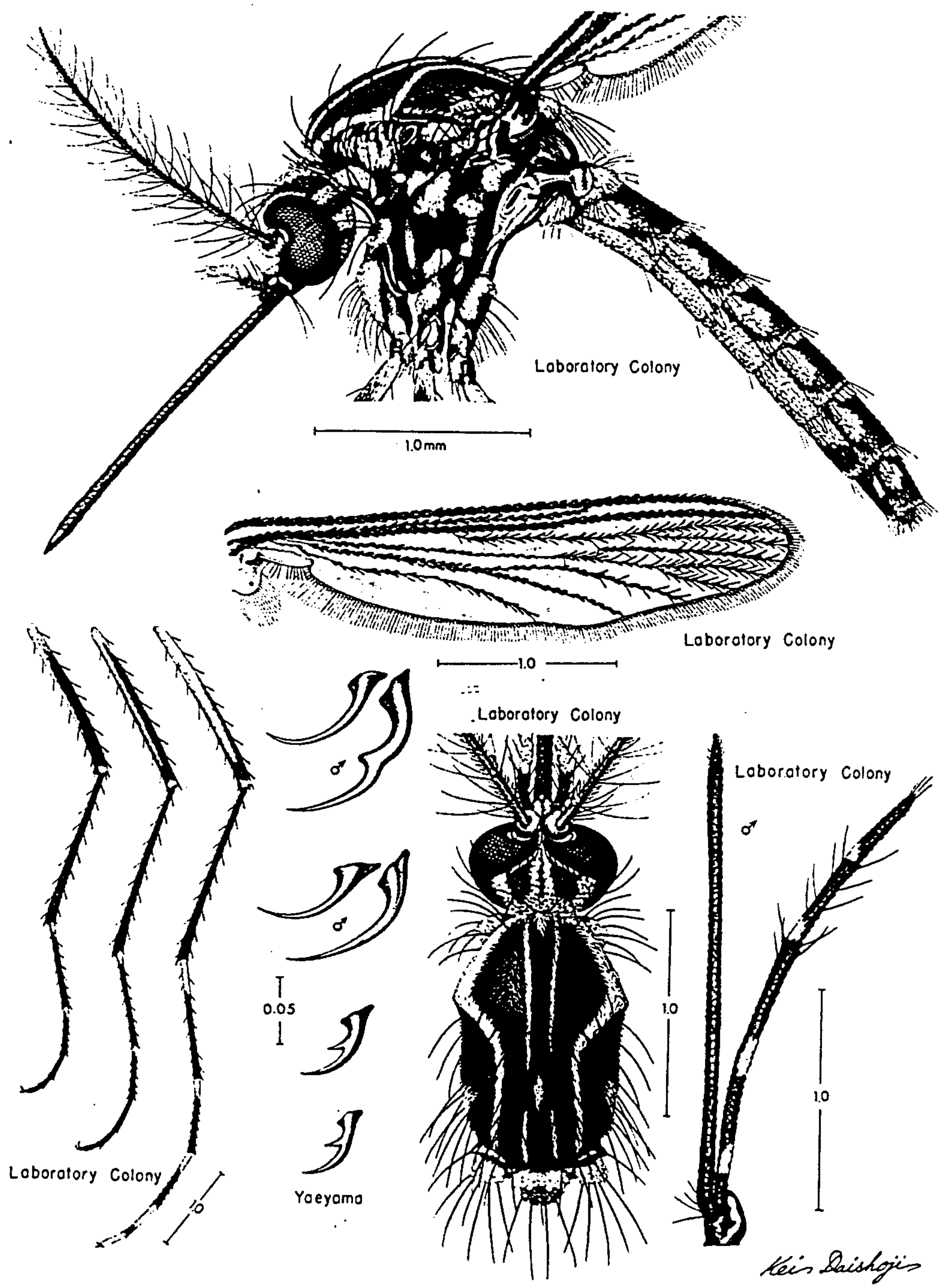

Figure 2-- Enlarged drawing of *Aedes aegypti* anatomy.(Tanaka, K., Mizusawa, K., Saugstad, E.S. 1979 *Mosquitoes of Northern Japan and Korea.* Contr. Amer. Ent. Inst. Vol. 16.)

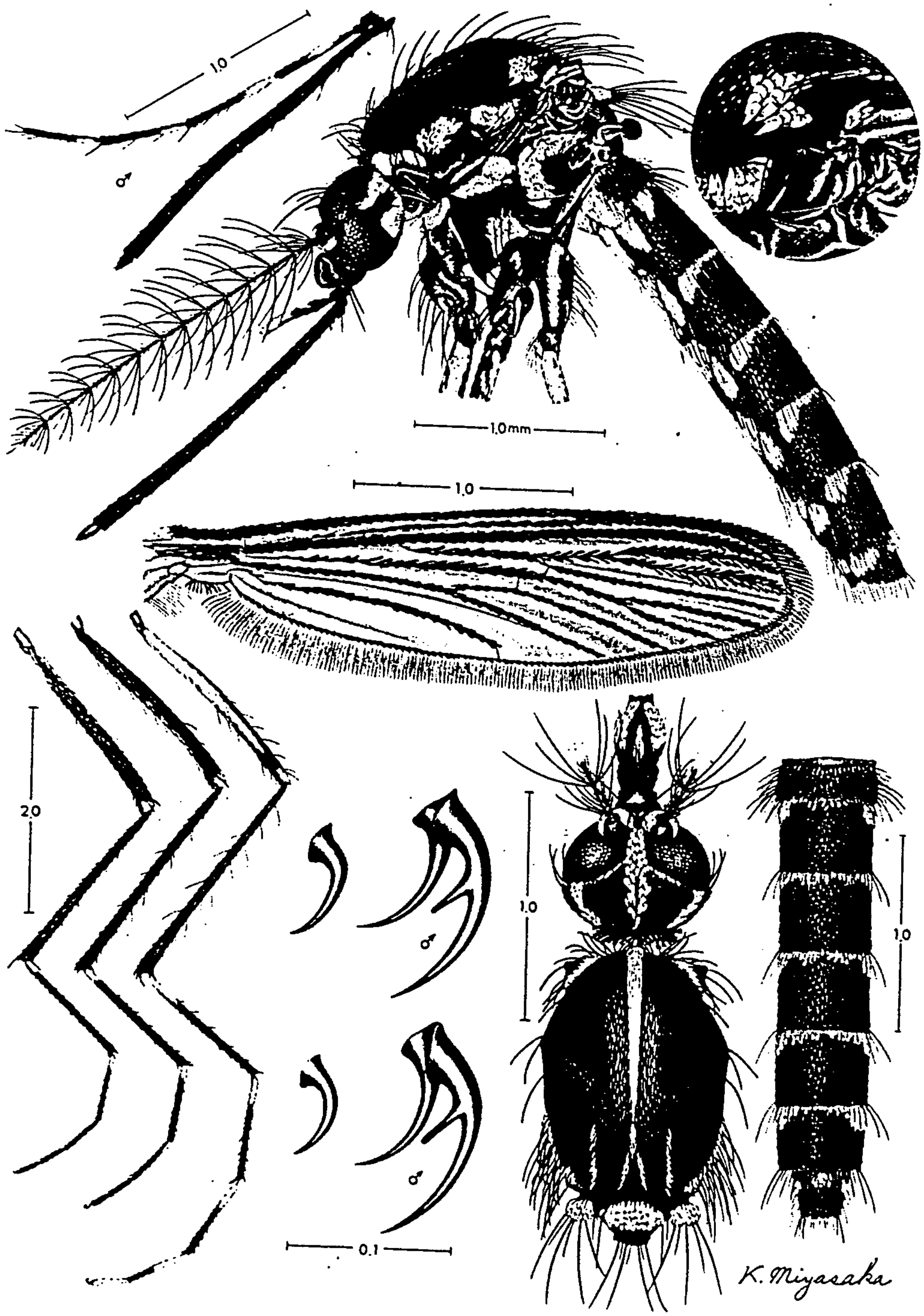

Figure 3-- Enlarged drawing of *Aedes albopictus* anatomy.(Tanaka, K., Mizusawa, K., Saugstad, E.S. 1979 *Mosquitoes of Northern Japan and Korea.* Contr. Amer. Ent. Inst. Vol. 16.)

Table 1-- Tentative Identification of ovipaddles from Lackland AFB, TX. 'STEG' indicates the presence of Aedes (*Stegomia*) eggs which may be either *Aedes aegypti* or *Aedes albopictus*.
(.) indicates no ovipositioned eggs.

COLUMN CODES: SITENUM = SITE NUMBER, DCOLL = DATE COLLECTED,
AEGYPTI = Aedes aegypti, TRISER = Aedes triseriatus OTHER CODES ARE:
STEG = Aedes spp., ALBO = Aedes albopictus, EPAC = Aedes epactius
FOR QUESTIONS CALL Chad McHugh @ DSN 240-2063

------------------------------- EK=27E065 -------------------------------

BASE	DCOLL	SITENUM	AEGYPTI	TRISER	OTHER	NUM
LACKLAND	20MAY94	1	0	0	STEG	6
LACKLAND	20MAY94	2	0	0		.
LACKLAND	20MAY94	3	0	0	STEG	8
LACKLAND	20MAY94	4	0	0		.
LACKLAND	20MAY94	5	0	0	STEG	5
LACKLAND	20MAY94	6	0	0	STEG	6
LACKLAND	20MAY94	7	0	0	STEG	1
LACKLAND	20MAY94	9	0	0	STEG	27
LACKLAND	20MAY94	10	0	0	STEG	2

Table 2-- Final evaluation of fully developed eggs.
Site 7's only egg did not hatch

COLUMN CODES: SITENUM = SITE NUMBER, DCOLL = DATE COLLECTED,
AEGYPTI = Aedes aegypti, TRISER = Aedes triseriatus OTHER CODES ARE:
STEG = Aedes spp., ALBO = Aedes albopictus, EPAC = Aedes epactius
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------------------------------- EK=27E065 -------------------------------

BASE	DCOLL	SITENUM	AEGYPTI	TRISER	OTHER	NUM
LACKLAND	20MAY94	1	0	0	ALBO	6
LACKLAND	20MAY94	2	0	0		.
LACKLAND	20MAY94	3	0	0	ALBO	8
LACKLAND	20MAY94	4	0	0		.
LACKLAND	20MAY94	5	0	0	ALBO	5
LACKLAND	20MAY94	6	0	0	ALBO	6
LACKLAND	20MAY94	7	0	0	STEG	1
LACKLAND	20MAY94	9	2	0	ALBO	25
LACKLAND	20MAY94	10	0	0	ALBO	2

AN ANALYSIS OF OIL/GREASE IN WATER AND SOIL

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Final Report for:
High School Apprentice Program
Armstrong Laboratory

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Abstract

An analysis of oil and grease in water and soil samples was conducted. Water samples were measured in 500 ml flask containers with and addition of freon and Sulfuric Acid (H_2SO_4). The samples were agitated by hand and by machine for three minutes. After this process, the samples were extracted into 10 ml cylinders. Soil samples were weighed out and freon was added. These were stirred for two minutes and extracted into cylinders.

Soil and water samples were investigated for pollutants. An analysis of oil and grease was conducted. Water samples were measured in 500 ml flask containers with freon and Sulfuric acid (H_2SO_4) added. These samples were agitated by hand and by machine for three minutes. After this process, the samples were extracted into 10 ml cylinders. Soil samples were weighed out and freon was added. These samples were stirred for two minutes and extracted into cylinders.

Introduction

The analysis of oil and grease in water and soil is important to any community. If water or sold contains an abnormally high content of oil and grease, it could affect an entire population with deadly results. Farmers and ranchers could suffer if their crops or cattle are subjected to these contaminants. Wildlife could be eradicated because of this environmental threat. Analysis are conducted to make certain that no water or soil supply has been tainted with pollutants. These resources could be polluted by airplane and train accidents involving hazardous materials, industrial pollution, and human carelessness.

Methodology

Water
The analysis of this resource was conducted by using freon and Sulfuric Acid. 500ml of the sample were poured into a flask. To this, 20ml of freon and 5ml of Sulfuric Acid (H_2SO_4) were added. This flask was placed in a mixing machine for 3 minutes for additional agitation. The container was removed from the machine and placed on a rack. The water, along with the freon and the acid, was suspended as the oil ad grease that remained. The observations were recorded.

Soil
Freon was used in this investigation. 50 grams of soil were weighed, and 50 ml of freon were added to each sample. This was hand stirred for two minutes to extract the oil and grease from the soil. The sample was filtered into a 25 ml cylinder and run through an IR machine to detect any traces of contaminants in the soil. The findings were recorded.

A STUDY OF THE PRACTICALITY OF AN AUTOMATED AIRFIELD DYNAMIC CONE PENETROMETER

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A STUDY OF THE PRACTICALITY OF AN AUTOMATED AIRFIELD DYNAMIC CONE PENETROMETER

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Abstract

Captain David Weintraub's proposal and prototype for an Automated Airfield Dynamic Cone Penetrometer was studied along with the original Dynamic Cone Penetrometer. An AADCP would reduce manual labor, reduce the time required for testing, and increase the accuracy of the results. However, a more complicated device presents more complicated problems, both in the field and in the Lab. This study was undertaken to determine whether or not Captain Weintraub's AADCP was a practical replacement for the DCP.

A STUDY OF THE PRACTICALITY OF AN AUTOMATED AIRFIELD DYNAMIC CONE PENETROMETER

STEVE J. MATTINGLEY

Introduction

The general mission of the Air Force has changed greatly in the past decade. The ability to project a strong military presence anywhere in the world relatively quickly has become even more important. Specifically the Air Force must be able to fly into and out of third world countries on substandard airfields. The Air Force has used several tools to evaluate airfields. The Airfield Cone Penetrometer and the Dynamic Cone Penetrometer have both been used by the Air Force to evaluate the potential number of safe landings and takeoffs that an airfield can accommodate. The various penetrometers all give different types of readings, so they are all correlated with the California Bearing Ratio (CBR). The Airfield Cone Penetrometer was used by the Air Force to test runways from the 1950's to the 1980's. The ACP had several major limitations. First, it could only penetrate soil with a CBR rating of less than 15. Normal unsurfaced airfields have CBR's of 30 or less. Second, the ACP didn't provide an accurate correlation with the CBR. Therefore, judging the results of a test was difficult. The Dynamic Cone Penetrometer is very accurate and simple to use. However, it is labor intensive and time consuming to do a full test with the DCP. Therefore an Automated Airfield Dynamic Cone Penetrometer was proposed and then designed by Captain David Weintraub. This study was undertaken to determine the usefulness Captain Weintraub's AADCP and the practicality of modifying the DCP for future use.

Methodology

The Automated Airfield Dynamic Cone Penetrometer (AADCP) is an automated version of the DCP. Penetrometers measure the shearing strength of the soil. The shearing strength is a ratio of inches per blow. That number is then correlated with the CBR. This research is based on the AADCP designed and built by Captain David Weintraub when he was working on his Ph.D. Dissertation. The AADCP was not operational when this project was started. Therefore the first step of the research was to come to a basic understanding of how the AADCP works and then to reassemble it.

The AADCP consists of a penetration rod, a solenoid and quick exhaust valves, a piston and spring, and a 20 pound mass on top. The AADCP also requires an air compressor, air tank, and battery. The penetration rod is 36 inches long and has a 16 mm diameter. The penetration rod has a steel tip with a diameter of 20 mm and 60 Degree cone apex. The basic operation of the AADCP is as follows: the air compressor is run by a small gasoline powered engine. The compressor fills the tank with air at about 110 PSI. A toggle switch is then toggled and air is let through the solenoid valve. The compressed air raises the piston within the cylinder a total of two inches. A magnet inside the piston triggers a magnetic position switch positioned on the outside of the cylinder. The magnetic position switch sends a signal to the Digital Blow Counter and to the exhaust portion of the solenoid valve. As soon as the compressed air is released, the force of the 285 lb. spring and the 11 lb. mass on the piston drive the piston onto the anvil. The anvil is directly connected to the penetration rod. One cycle of the AADCP has then been completed. Once the toggle switch is hit again the cycle begins again.

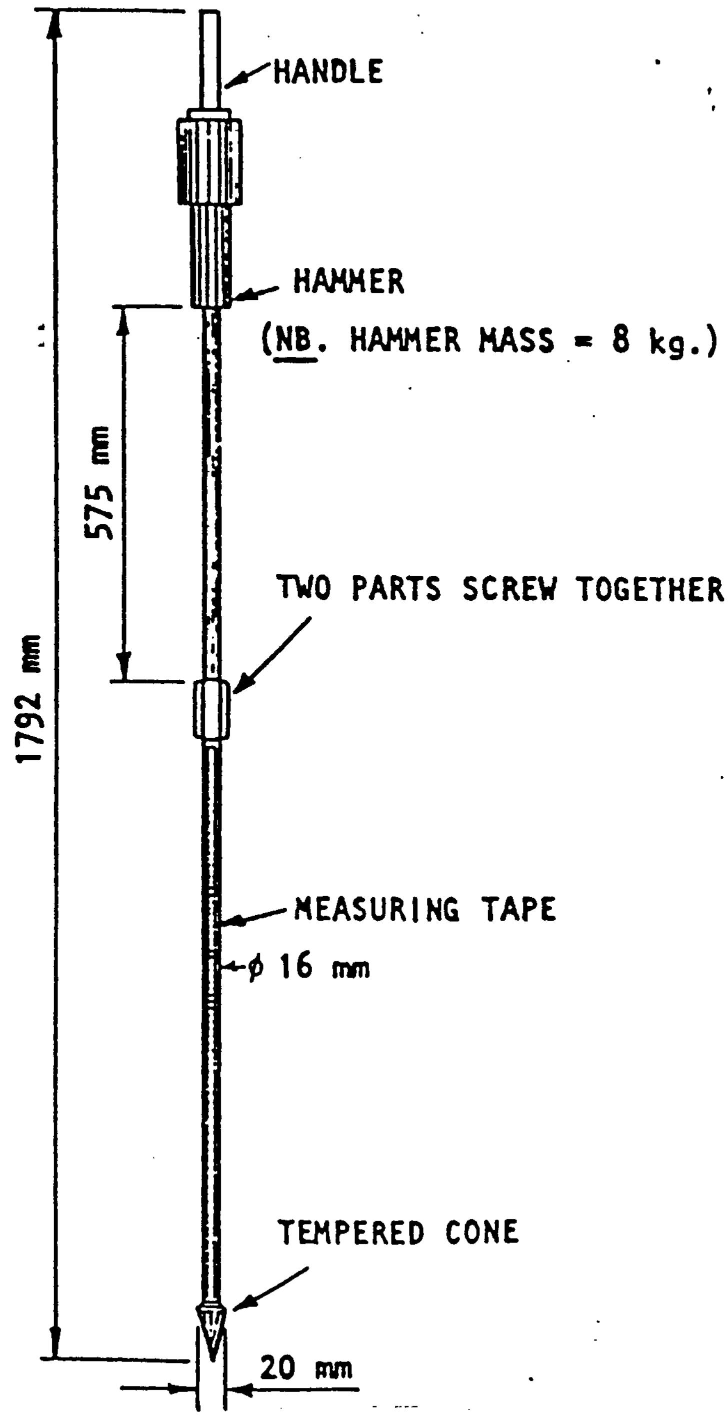
The first segment of reassembly was to rewire the AADCP. The Digital Blow Counter and the Magnetic Position Switch were examined to determine how to connect them to the toggle switch and solenoids. Captain Weintraub was contacted to verify the accuracy of the wiring. With Weintraub's information, the wiring was reconnected. The "hot" wire from the battery was attached to the corresponding red wire on the magnetic position switch. The ground wire coming from the battery was hooked up to the black wire on the magnetic position switch. The remaining battery wire and the green "supply" wire of the magnetic position switch were both attached to the digital blow counter at the 5-48 Volt positions. A power source was connected to the battery terminals and a magnet was run underneath the Magnetic Position Switch. The digital blow counter "counted" each pass of the magnet.

The second step of the project was to reattach the air compressor, air tank, gas engine, and 12 Volt battery. The decision was made to attach the engine and the compressor to an aluminum plate rather than the wooden plate used by Captain Weintraub. Holes were drilled in the plate to mount the components. The components were then bolted down to the aluminum plate.

A regulator and compression fittings were added to the air compressor. The digital blow counter was "attached" to the toggle switch with epoxy. Many of the wires were wrapped together and then taped. That made the machine slightly easier to handle and helped prevent wire tangles.

A full equipment check was then attempted. An electric air compressor was used because the gasoline powered motor didn't have enough power to compress air beyond 15 PSI. The compressor was hooked up to the air intake hose and the battery cables were attached to the 12 volt Battery. As air pressure built up, the 11 lb. mass slowly rose to the top of its stroke. The solenoid valve had to be manually switched, but piston did fall after it was switched. A faulty seal was found at the base of the cylinder and subsequently replaced. The test was attempted again, and the pressure built up much faster but the solenoid valve still did not function properly. It was conjectured that the magnet wasn't in place inside the piston. That would have prevented the solenoid valve from being triggered by the magnetic position switch. After further research, it was found that the magnet was built into the cylinder. The solenoids were not working correctly, but the AADCP was seen in action. With the damaged solenoid valves and the fact the AADCP can't currently be tested in the field because the gasoline powered engine isn't powerful enough it was decided to research alternatives to the AADCP.

The first step in this research was to examine the machine that the AADCP was designed to replace (see 24-6). The DCP consists of a penetration rod approximately 1 meter in length. The penetration rod is attached to an anvil. The anvil is struck by an 8.2 KG weight falling close to two feet. The DCP is 1.7 meters tall and a much simpler device than the AADCP. The weight is hand raised by one operator and the number of blows per inch is measured and counted by another operator. The DCP is quite labor intensive and a full test could take an entire day if attempted by one crew of two men. A full test would entail as many as 150 individual test sites. Each requiring a penetration of at least 24 inches. Those were the primary reasons for attempting an Automated version of the DCP o begin with. Therefore it was conjectured that if an alternative measuring and counting system could be employed, it would reduce the required man down to one. The device would still be labor intensive and time-consuming to use but it would only require one man to use. Two men could then each use one of the devices and thus get the job down in half the time it would take a standard DCP.



Dynamic Cone Penetrometer

Results

After working with the AADCP for the duration of the project, it has been decided that the current design of the AADCP is impractical for use by the Air Force. The following paragraphs offer the reasoning behind this decision and various ideas for improving both the AADCP and the DCP.

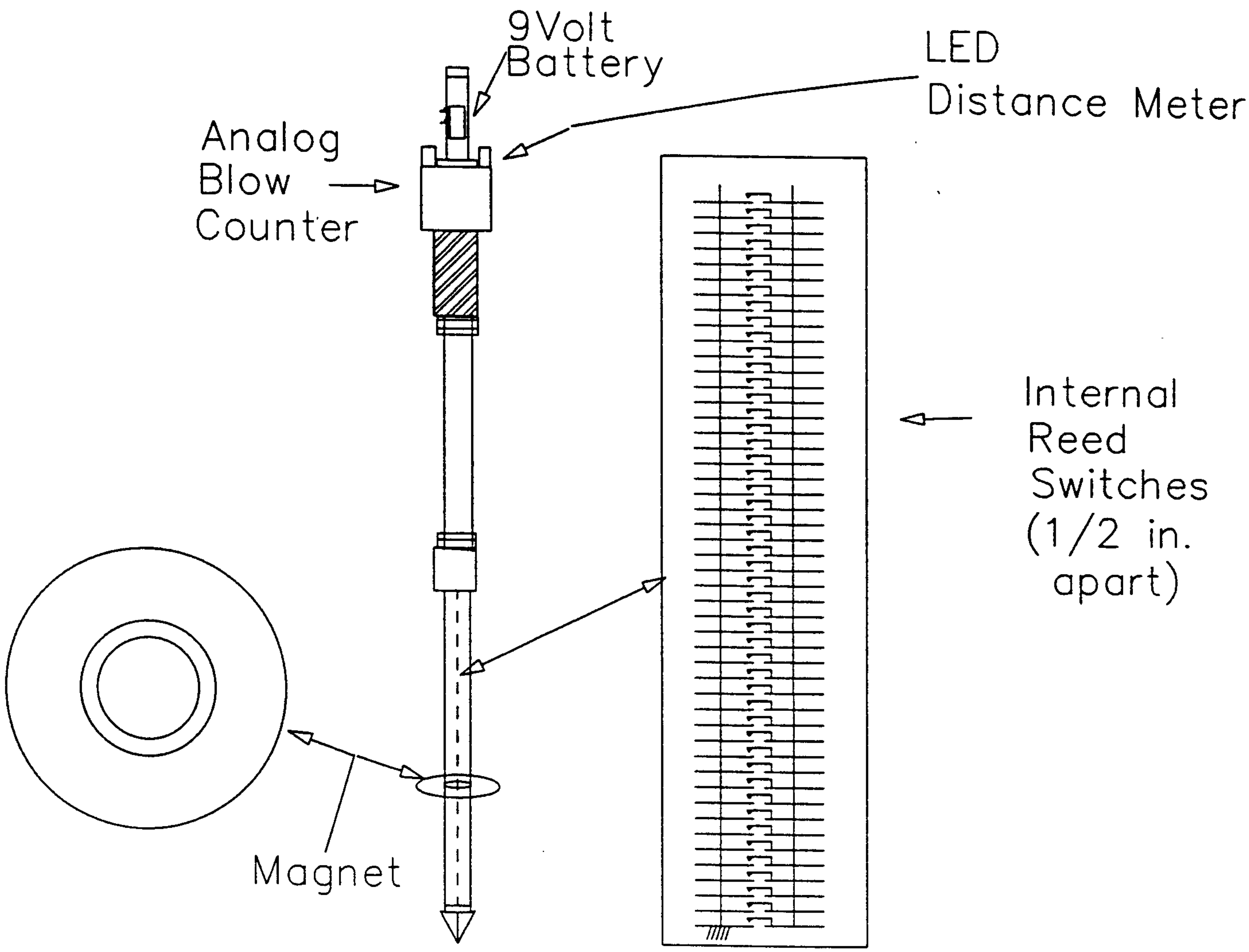
The Air Force must operate in many different climates and in any type of weather. The current design of the AADCP with its electrical equipment and wiring would be cumbersome in the field. The wires would easily entangle themselves on vegetation, malfunctions are always a possibility, and they could become loose in the field. The gas powered engine, air compressor, air tank, and battery add quite a bit of weight and bulk to the AADCP. The battery must be kept level at all times to prevent an acid spill. The gas powered engine would be a burden to refuel in the field and it is probably too noisy for operations were stealth is necessary. The original device used a wooden carrier. The aluminum replacement carrier is adequate, but other lightweight materials need to be investigated.

Another possible problem with the AADCP is the difficulty of maintaining it and all of its components in the field. One would have to be capable of repairing the AADCP itself, along with the air compressor and the gasoline powered engine. Spare parts and tools would have to be carried for all three major components, adding to an already heavy load. Personnel would have to be trained in the repair and the operation of the device.

One possible method of improving the AADCP would be replacing the electrical systems with mechanical systems. The solenoids could be cam operated and the digital blow counter could be replaced with an analog counter. That would eliminate the need for the magnetic position switch and all the wiring. Using a self powered air compressor would eliminate the need for a seperate engine. Thus, the machine would still be bulky, although it would be simpler to operate and repair.

Several modifications to the DCP would make it operable by one man (see 24-8). A terminal strip of reed switches would be placed inside a hollow penetration rod. The reed switches could be placed evenly at half inch increments or closer together for more accurate readings. The reed switches would be activated by an external circular nylon position indicator with a magnet inclosed. This circular position indicator would rest on the ground and the penetration rod would be driven through it. Once activated, a reed switch would send an electrical pulse to

Modified Dynamic Cone Penetrometer



a self powered digital counter which would show the distance penetrated. The wiring would run through the penetration rod which would be made of a non-magnetic stainless steel alloy such as 316. An analog blow counter would be placed across from the distance indicator. The entire system of reed switches would run off a 9-volt battery, which would be stored in the handle of the DCP. Small spare parts and possibly extra batteries could also be stored in the handle. Nylon noise reducers could be placed on the bottom of the falling weight and the top of the anvil, to help keep it quiet. The anvil would allow the penetration rod to be screwed into its base just like the unmodified DCP. That makes the DCP much easier to transport by reducing it into two components, the penetration rod (1 meter) and the rest of the device (.8 meters).

Conclusion

The AADCP is not yet a viable alternative to the DCP, maninly because it is extremely bulky and not field operable. However, with a self powered air compressor and perhaps a mechanical operating system, it would have a much better chance of succeeding the DCP. If it is found that the AADCP won't be capable of replacing the DCP, then modifying the DCP for one man operation has much merit. If that cannot be done or isn't feasible, then perhaps a completely new device should be designed and tested.

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Weintraub, David. Ph.D. Dissertation, University of Florida, 1993. Copyright 1993.

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This project was accomplished in full association with Wright Laboratory and my mentor Edwin Duncan.

DIGITIZING OF TECHNICAL ILLUSTRATIONS

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Final Report for:
High School Apprentice Program
Armstrong Laboratory

Sponsored by:
Air Force Office of Scientific Research
Bolling Air Force Base, DC

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August 1994

DIGITIZING OF TECHNICAL ILLUSTRATIONS

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Abstract

Prior research conducted by the Armstrong Laboratory's Logistics Research Division (AL/HRG) to improve the performance of maintenance personnel concentrated on ways to present technical information in a manner that would improve performance. A specific area in which this research becomes especially useful is the area of Aircraft Battle Damage Assessment and Repair (ABDA/R). AL/HRG has developed an assessment tool to aid in the ABDA/R process, and the users have responded favorably to the graphical based presentation of technical information.. In order to provide this graphical presentation of data, it is necessary to convert technical illustrations from paper into digital format. To accomplish this conversion, a process was researched, established, and fine-tuned for converting graphical images from paper to intelligent electronic graphics. Multiple paper technical illustrations were converted to intelligent electronic graphics using this newly established process and presented on the Portable Maintenance Aid (PMA).

DIGITIZING OF TECHNICAL ILLUSTRATIONS

Elizabeth A. McKinley

Background

Prior research conducted by the Armstrong Laboratory's Logistics Research Division (AL/HRG) to improve the performance of maintenance personnel concentrated on ways to present technical information in a manner that would improve performance. This, plus advances in computer technology, led to research to apply this technology to present technical data and to develop automated diagnostic aids. It became clear that performance could be improved most by providing the technician with a single system that provided not only technical data and diagnostics, but all related and supporting information as well. The Integrated Maintenance Information System (IMIS) program was developed to show the feasibility and payoff of meeting this need. The IMIS, an ongoing advanced development demonstration project, is developing and field testing the technology to enable a maintenance technician to access all necessary information via a hand-held portable computer. The information includes interactive diagnostics instructions, work orders, supply availability and ordering, historical data, and training materials. Although the information provided may come from several data bases (e.g., the Core Automated Maintenance System and the Standard Base Supply System), the technician only has to deal with a single, integrated system and its user interface. IMIS is designed to be totally integrated with other maintenance information systems during peacetime at main operating bases, but is also fully deployable to remote, dispersed locations.

A specific area in which IMIS becomes especially useful is the area of Aircraft Battle Damage Assessment and Repair (ABDA/R). Rapid and accurate ABDA/R can be an effective force multiplier in combat operations. The key is rapid and accurate assessment of damage to determine which aircraft can be rapidly repaired and returned to combat. Assessing today's highly sophisticated and complex aircraft is challenging for experienced technicians, let alone first-term airmen. The assessor literally needs to know the aircraft inside and out. Few technicians have the requisite knowledge and skills, and qualified assessors may not be available at the aircraft location (e.g., a damaged F-16 may land at A-10 base). Previous AL/HRG research suggests that an automated assessment aid which provides the assessor with specialized technical information, presented in a format specifically designed to support the assessment task, would be a major asset. Such an aid would provide the technician with access to integrated information, including engineering drawings, flight tolerances, and complete technical orders for the aircraft. The IMIS provides the capability to store and present this information and can be the basis for an assessment aid.

Introduction

In previous research at HRG, an assessment aid has been implemented and the users have responded favorably to the graphical based presentation of technical information. This presentation technique provides the assessor with easily accessible information which is easy to interpret and understand. This is true because in the ABDA/R program a graphical image of the entire plane to be assessed and repaired is displayed and then from that image a smaller section of the plane can be selected (e.g., the wing) and assessment of that item can be performed. This easy to interpret and understand graphical image is much better than displaying text based information. In other words, a picture is worth a thousand words.

In order to provide this graphical presentation of data, it is necessary to convert technical illustrations from paper into digital format. This digital format provides the necessary selectable capability for easy traversal through the technical information and assessment process. Each graphic image is made up of several selectable areas which represent actual areas or objects within the aircraft (e.g., the wing, the inboard torque box). Once an area or object has been selected (link to the tests) it can be assessed as destroyed, damaged, suspected, or OK. From here the technician may be required to perform tests or may just need to perform the repair. Graphical images are also used to show details of how to perform the repair.

Process

To accomplish this capability, a process was researched, established, and fine-tuned for converting graphical images from paper to intelligent electronic graphics. The first thing that needed to be done was to get the paper image into a digital format that was useful on the computer. This was accomplished by using a scanner and good graphic scanning software. When one of these drawings is scanned into the computer, it comes in as a bit map. In other words, it comes in as an image made up of thousands of pixels which are selectable. Since it would be a very long, time consuming process to select every pixel that made up a line, it became necessary to convert the image from a bit map to vector lines. To convert the graphics to vectors, it was necessary to import the bit maps into a graphic design software package and trace them with vector lines. When the graphics were completely traced the bit map was deleted and only the newly created vector graphic remained.

The technical illustration is now in electronic format, but the graphic is still not intelligent. An intelligent graphic is one that is constructed from several different overlays, contained selectable items representing real systems or components, and these selectable areas were linked to other technical information (e.g. tests, tasks, other graphics, etc.) for use in electronic display. To accomplish this part of the conversion, a government developed authoring system was used to create the selectable area, create the overlays, and link other technical manual information to each selectable region. Once this was accomplished, the technical information was ready to be viewed and used in the Portable Maintenance Aid (PMA).

Listed below is a typical scenario that an aircraft battle damage assessor would go through using the AL/HRG Assessment Tool. The figures, at the end of this report, show actual screen captures from the assessment tool software while the text below describes the figures and the actions that are occurring. This assessment scenario is using data for a Navy F/A-18 aircraft, but data for other aircraft (F-15, F-16, etc.) is also available.

Assessment Scenario

After receiving his tasks to be performed for the day, the technician would obtain a PMA containing the appropriate technical data for the current aircraft. The technician would then arrive at the aircraft ready to perform his task. After going through a few initial screens in the software, the technician would arrive at the screen shown in Figure 1.

Figure 1 shows a top-level view of the F/A-18 aircraft separated into its sections of Forward Fuselage, Center Fuselage, Aft Fuselage, Wings, Wing Tips, and External Fuel Tank. The technician cursors to the appropriate section of the aircraft that contains the damage and selects it. In Figure 1, the Forward Fuselage is selected. To assess the Forward Fuselage, the technician would press the ASSESS soft key and the screen shown in Figure 2 would appear.

Figure 2 shows the dialog box that accompanies each level of assessment during the process. The technician has a choice of four options: OK means that the current selected item has no damage; DESTROYED means that the item is missing or beyond repair and needs to be replaced; DAMAGED means that the item contains some amount of damage and may be repairable; and SUSPECTED means that the item may not have any physically seen damage but it could not be working, additional tests are required to determine the state of the item. After selecting DAMAGED, and pressing the NEXT key, the screen in Figure 3 appears.

The technician has told the assessment software that the Forward Fuselage is damaged. At this point n exploded view of the Forward Fuselage is shown to the technician for more detailed assessment to be performed. In Figure 3, Door 13R has been selected, but the message at the bottom of the screen tells the technician that Door 13R has Not Been Assessed. Using the same dialog as shown before, the technician determines that Door 13R is also DAMAGED. After performing a removal of Door 13R, the screen in Figure 4 appears to the technician.

Figure 4 shows the equipment bay that is located behind Door 13R. This equipment bay contains many different components that need to be assessed. The component selected is one of the Flight Control Computers. Once again the technician needs to determine the amount of damage that has occurred. In some cases the technician may want an alternate view of the current component to perform his assessment. To obtain an alternate view, the technician would press the VIEW soft key, and the screen shown in Figure 5 would appear.

Figure 5 shows a more detailed view of the Flight Control Computer. This view allows the technician to cycle through the selectable items to perform his assessment on each component. In this screen the technician has selected one of the connectors/wires to assess. Using the same dialog box, the technician determines that the connector/wire is DAMAGED.

At this point, the technician has proceeded to the lowest level in the current system-subsystem hierarchy. If at a higher level, the technician determined another item was damaged (such as the Wing, Door 14R, etc.); then at this point the technician would continue the assessment at that level. For this scenario, the technician only assessed one path through the data. After the technician has accomplished all of his assessment, the report shown in Figure 6 appears on the screen.

Figure 6 shows the tasks that need to be performed to repair any damaged items, replace any destroyed items, further troubleshoot any suspected components, and finally perform system health checks to determine that the repairs have fixed the problems. The tasks are grouped into two separate categories: Actions to Accomplish and Pending Actions. Those listed in Actions to Accomplish can be performed at the current time, while those listed in Pending Actions require a task listed above to be completed before this action can be taken. One would not want to repair Door 13R and place it back on the aircraft before the damage to the equipment bay behind Door 13R was completely finished.

Once the technician selects one of the tasks to perform, that repair/replace/test procedure is displayed for the technician. Figures 7, 8, 9 & 10 show some of the steps involved in a typical repair procedure for a wiring harness.

Discussion

It is a tedious process to convert technical illustrations originally drawn for paper into intelligent electronic graphics. This process is time consuming and very human intensive and possibly expensive. For new weapons systems that are being designed on computers using Computer Aided Design (CAD) and Computer Aided Engineering (CAE), then the conversion from a digital design drawing (minus its dimensioning and other information) to an intelligent graphic is more straight forward and easier to accomplish.

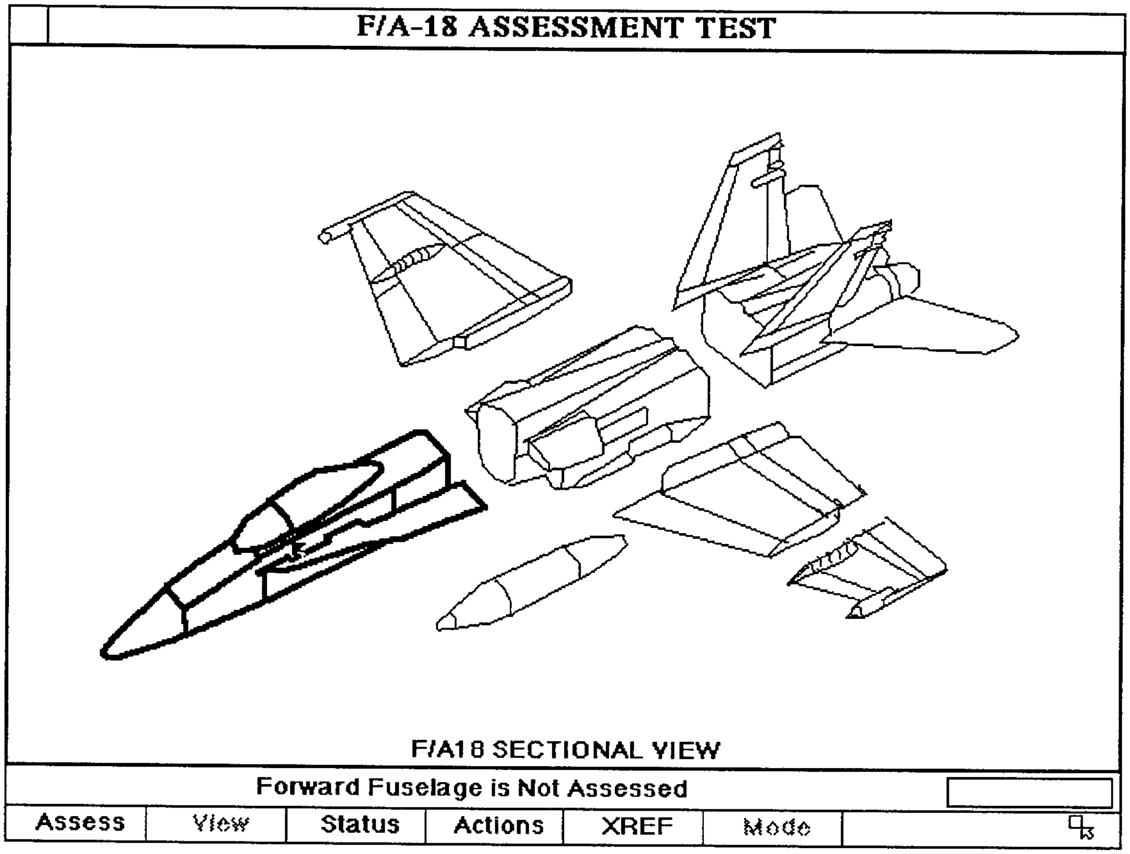


FIGURE 1: F/A-18 Aircraft Sectional View

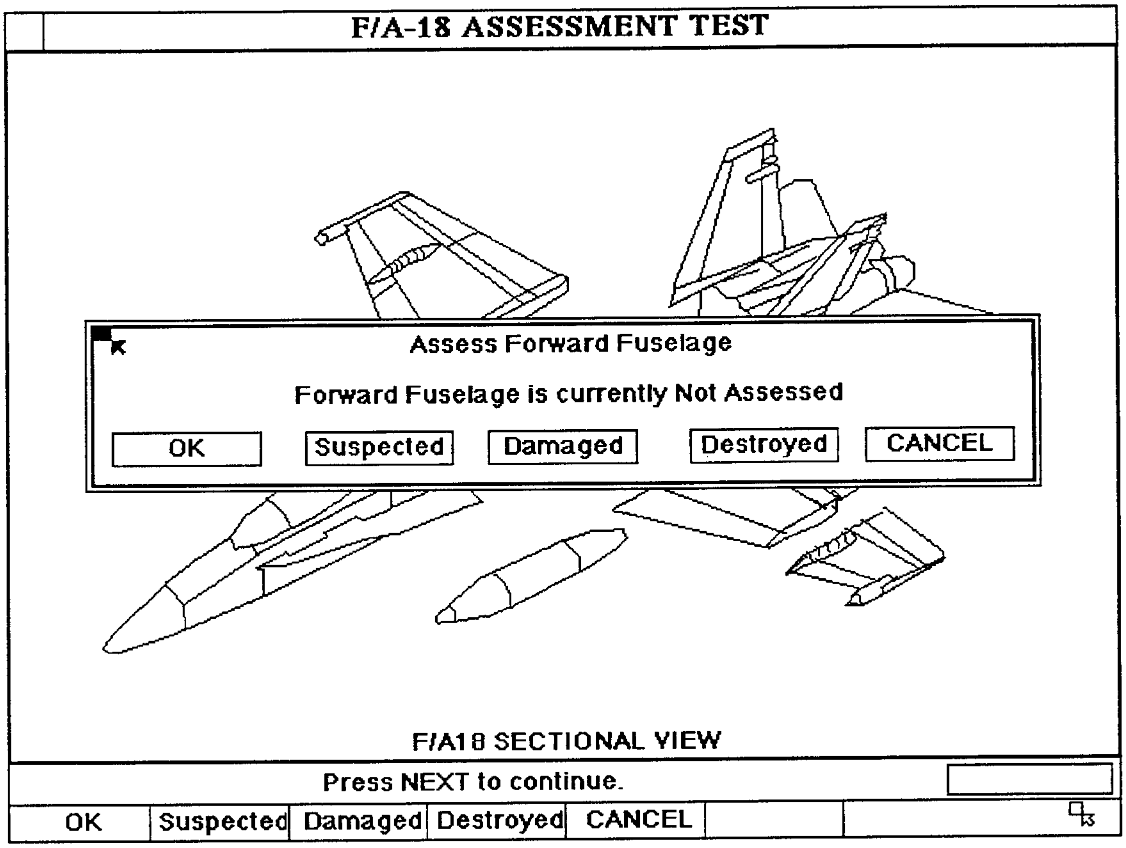


FIGURE 2: Assessment Options Dialog Box

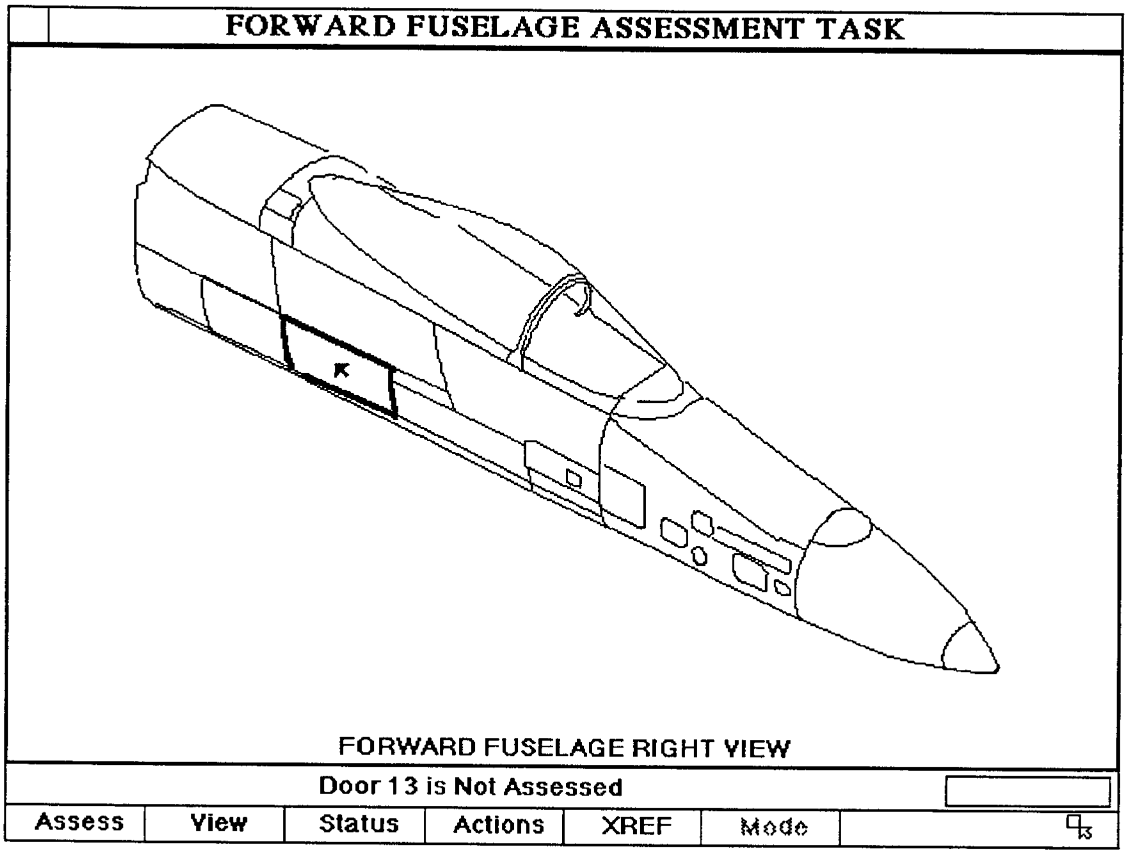


FIGURE 3: Forward Fuselage Right View

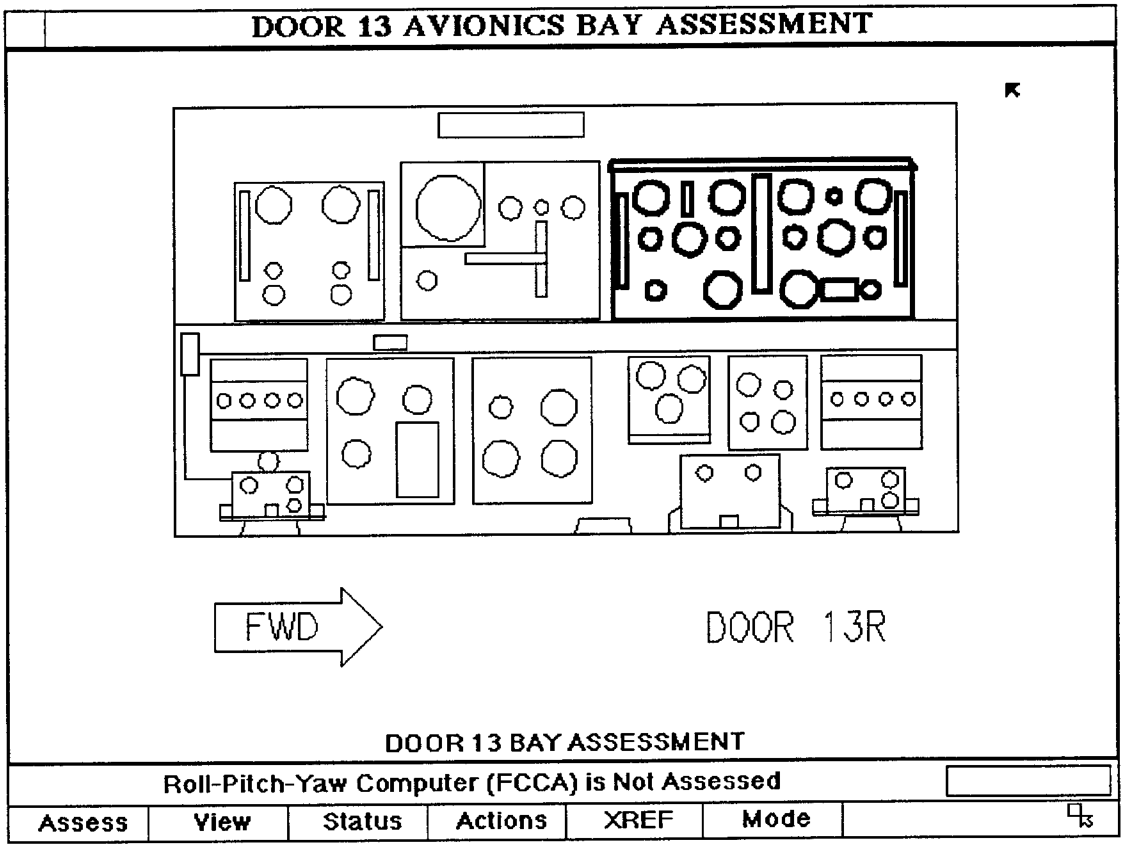


FIGURE 4: Door 13R Equipment Bay

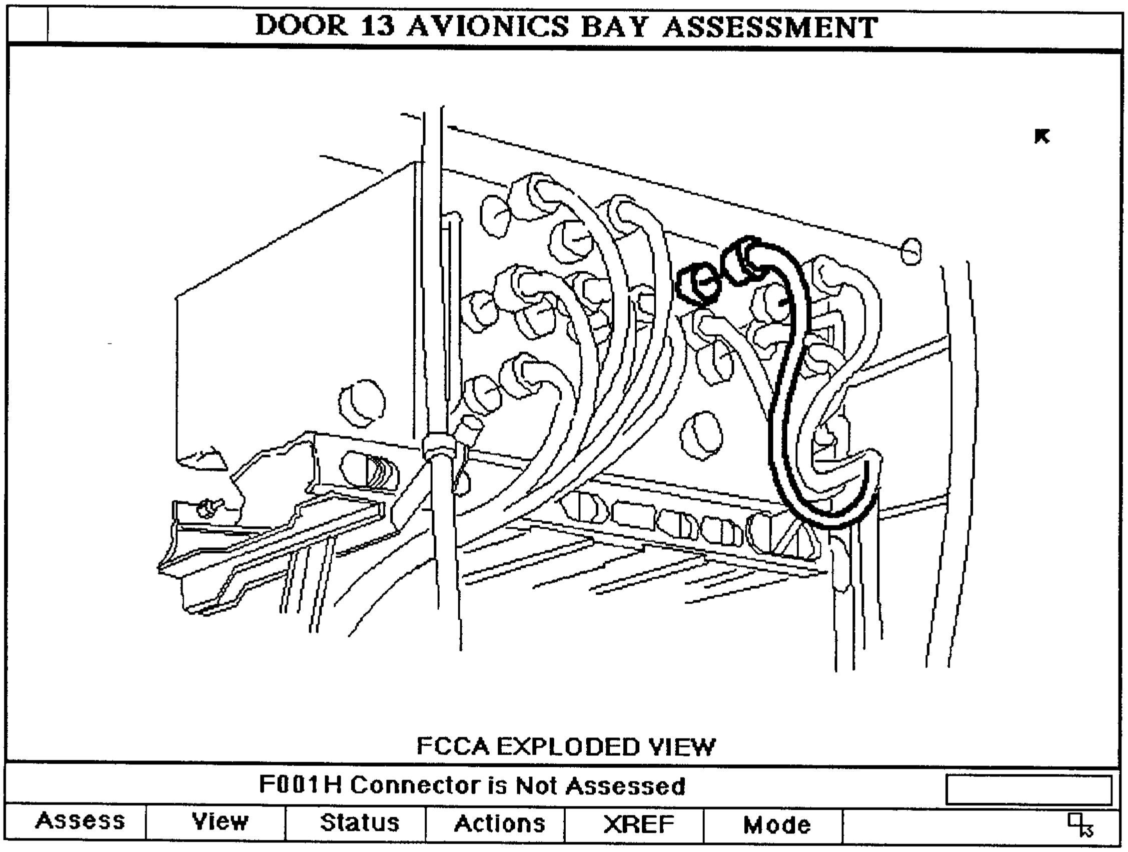


FIGURE 5: Flight Control Computer Exploded View

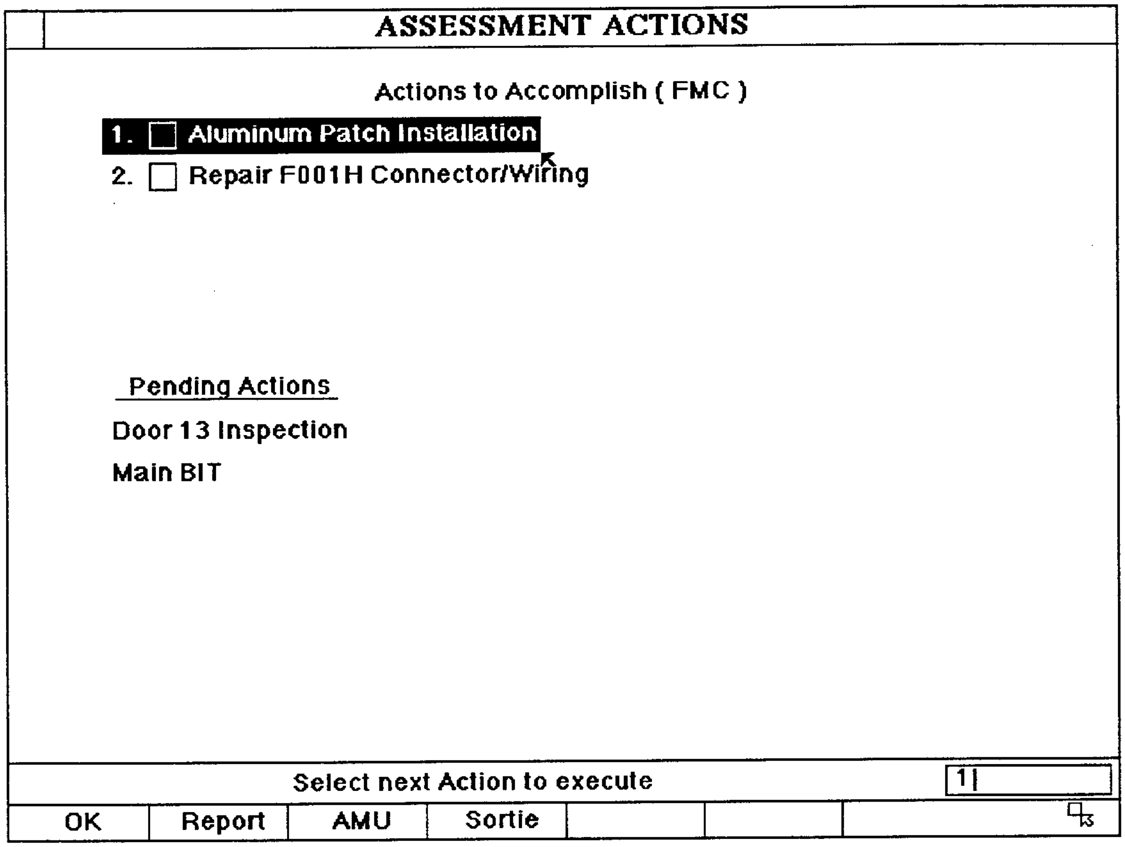


FIGURE 6: Assessment Actions Screen

REPAIR F001H CONNECTOR/WIRING

Input Conditions for:

Repair Of Multi-Conductor Shielded Cable

PERSONNEL REQUIRED: **None**

SUPPORT EQUIPMENT REQUIRED:

- **Nitrogen Servicing Unit - NAN-3**
- **Repair Set - Wire and Connector**
- **Heat Tool**

MATERIALS REQUIRED:

- **Tubular Shield Braid - 8660 (3/16-Inch)**
- **Conductor Splice - D-609-XX**
- **Tubular Shield Braid - 8664 (5/32-Inch)**
- **Tubular Shield Braid - 8674 (1/16-Inch)**
- **Solder Sleeve - NAS1745-XX**
- **Insulation Sleeve - M23054/5-XXX-0**
- **Insulation Sleeve - RNF100 1-8BLACK**
- **Tubular Shield Braid - 8661 (5/16-Inch)**

Press NEXT for Required Conditions.

Part Info	Supply					2

FIGURE 7: Initial Conditions Screen for Repair Procedure

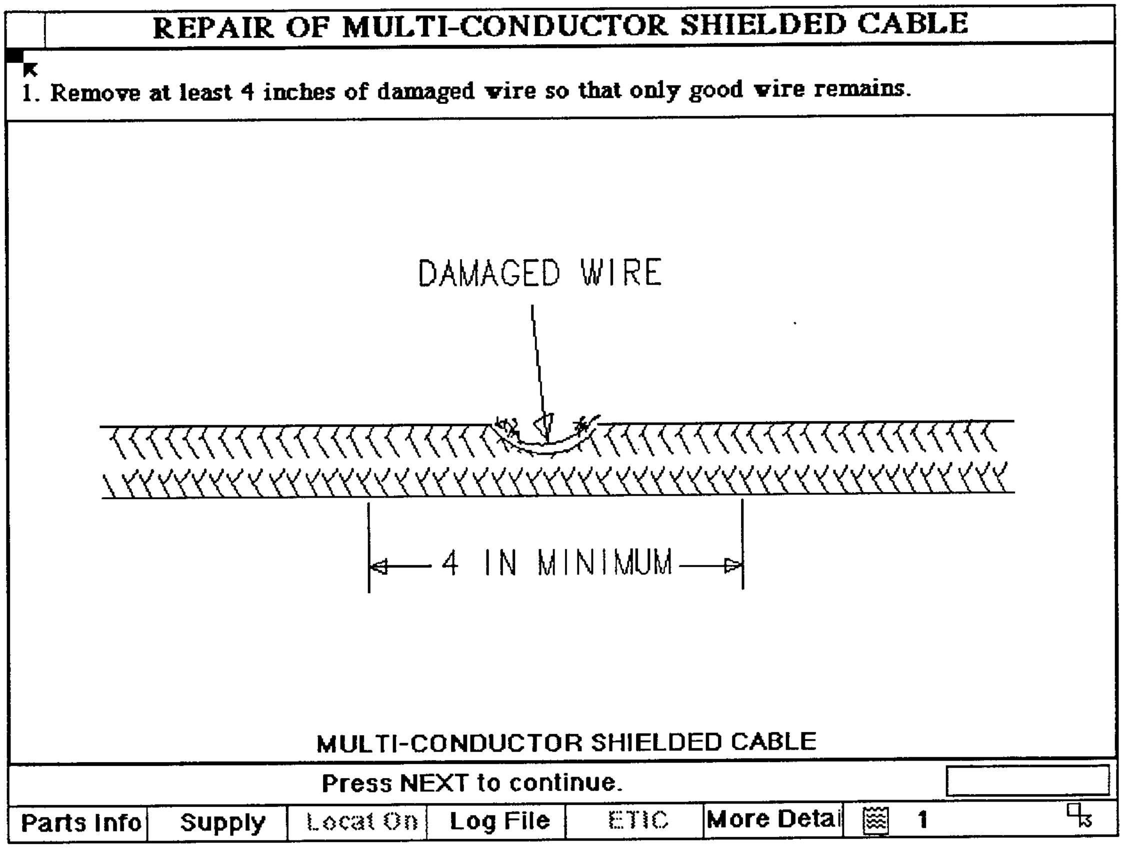


FIGURE 8: Screen Showing Step from Repair Procedure

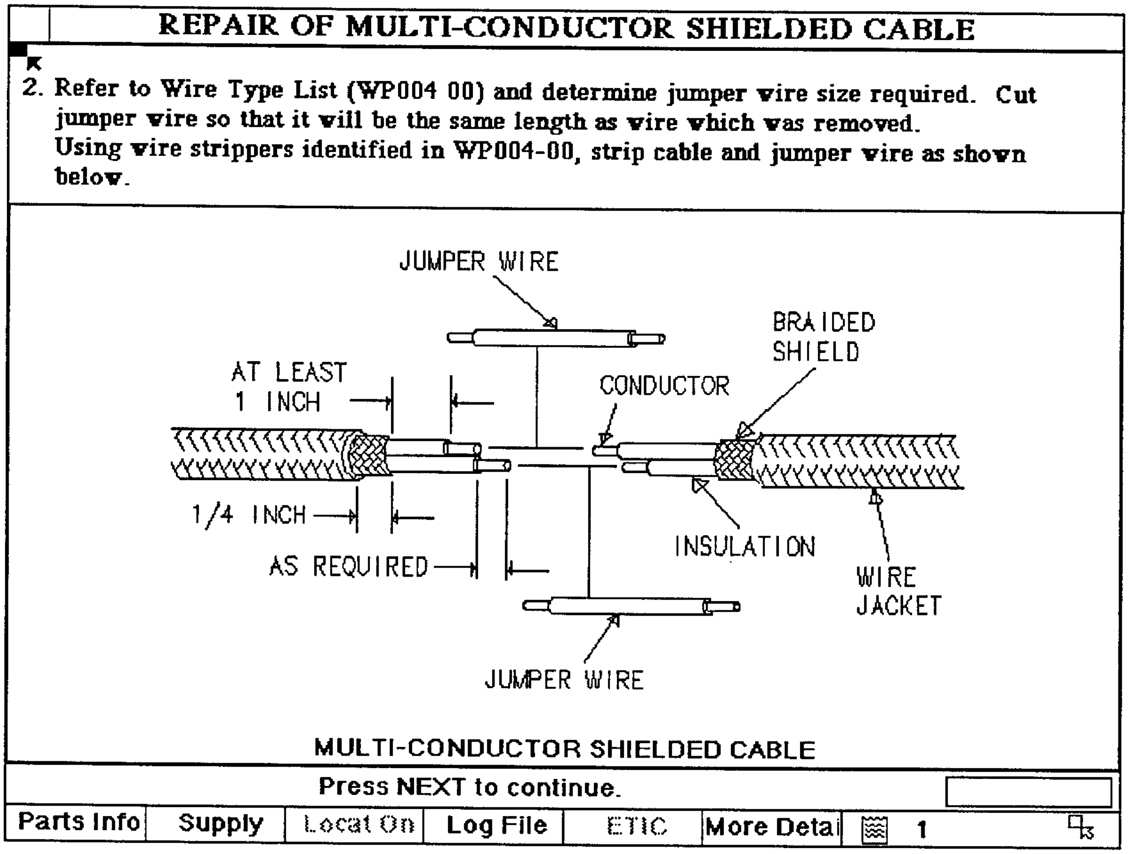
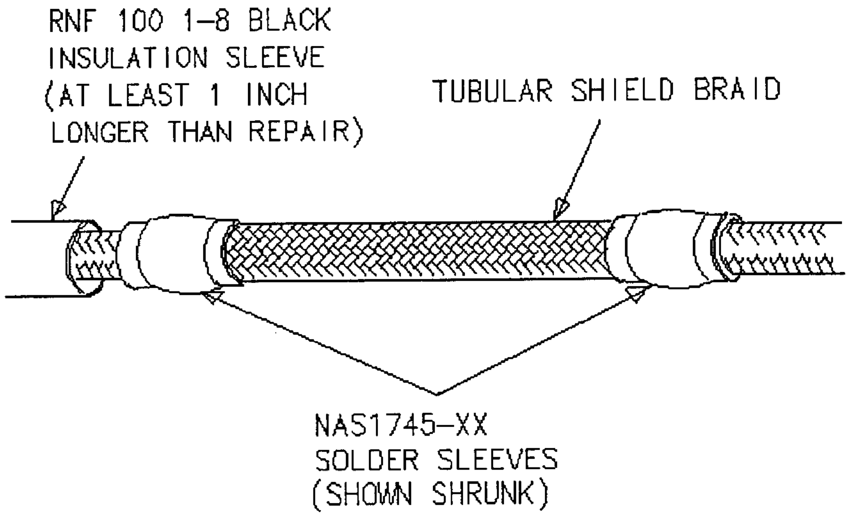


FIGURE 9: Screen Showing Step from Repair Procedure

REPAIR OF MULTI-CONDUCTOR SHIELDED CABLE

10. Shrink solder sleeves using heat tool.



MULTI-CONDUCTOR SHIELDED CABLE

Press NEXT to continue.

Parts Info	Supply	Locat On	Log File	ETIC	More Detai	⚠ 1

FIGURE 10: Screen Showing Step from Repair Procedure

Physical and Chemical Characterization of Columbus Air Force Base Aquifer

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Final Report for:
High School Apprenticeship Program
Armstrong Laboratory

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and

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August 1994

Physical and Chemical Characterization of Columbus Air Force Base Aquifer

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Abstract

A natural attenuation study (NATS) will be conducted on an aquifer in Columbus Air Force Base, Mississippi. A non aqueous phase liquid (NAPL) will be emplaced in the aquifer at Columbus AFB. Soil characterization prior to, and after emplacement of the NAPL is an essential step in monitoring the natural attenuation that occurs. Determination of total organic carbon (TOC) is part of the characterization to be determined prior to the emplacement of the NAPL. TOC analysis and surface area analysis was run on soil samples from the Columbus aquifer. The data obtained during this study is used to test predictive models of the course of natural attenuation. These models will help to determine the fate of groundwater contaminants, make contaminant cleanups more efficient, and help in developing methods for slowing down the spread of these contaminants. In order to make effective groundwater models, other research has to be performed. A sorption study was previously run on aquifers with different material compositions to see if there is any correlation between the composition of the aquifer and surface analysis, total organic carbon percent, cation exchange capacity, percent clay, percent silt, percent sand, and percent iron. The part that this report is concerned with only has to do with total organic carbon percent and specific surface area. If the sorption rate is low, the spread of the contaminants is retarded and natural attenuation tends to take place at a more rapid pace. By knowing total organic carbon and surface area, one would be able to approximate the sorption rate, by means of a simple formula, and therefore determine if natural attenuation would be the most practical means of cleaning a contaminant site. This information could also be used in designing predictive models for contamination cleanups.

Physical and Chemical Characterization of Columbus Air Force Base Aquifer

Amanda L. Olson

Introduction

Natural attenuation is a term used to describe the physical and chemical changes occurring in aquifers that diminish contaminant concentrations over time without human intervention. A field experiment called the Natural Attenuation Study (NATS) will be conducted by the United States Air Force AL/EQC in an unconfined aquifer at Columbus Air Force Base, Mississippi (Figures 1&2). This experiment has several research objectives which will provide information to support the process of natural attenuation as a remediation against contaminated groundwater sites. The tasks that must be performed in a natural attenuation action include characterization, monitoring, and predictive modeling. If this condition is realized within the site land parcel and no groundwater is being used from aquifer regions with contaminant concentrations exceeding water quality standards, natural attenuation is considered a successful remediation action. Part of the characterization process included meaasuring the total organic carbon percent of the soil samples at the NATS study site. By knowing total organic carbon, one would be able to approximate the sorption value, and then use this information to determine if natural attenuation would be the most practical means of cleaning a contaminant site.

Apparatus

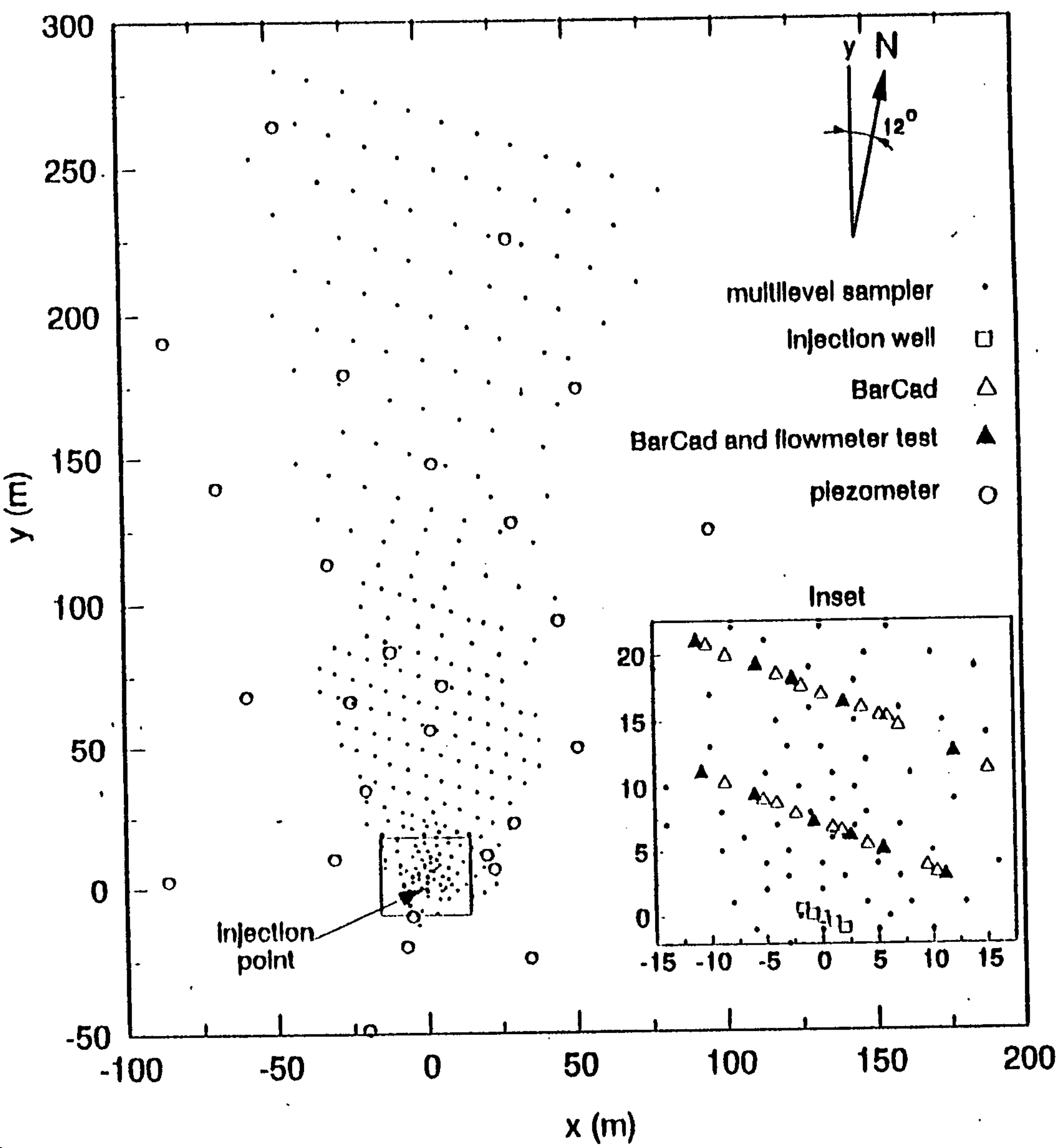
The apparatus used in this study consisted of a Leco Model WR112 Carbon Determinator. Crucibles used in the determination were baked in a muffle furnace at the temperature 1200 C for two hours to eliminate any moisture. The Leco carbon determinator measures the carbon in steel and a wide range of materials, in this study it was used for measuring carbon in soil. The sample was combusted in a high-frequency induction furnace. The carbon dioxide given off by this combustion is collected in a molecular sieve trap and then measured by thermal conductivity. The results are automatically for weight and calibration and then displayed as a percentage of carbon.

Methodology

Soil preparation

The twenty one core soil samples collected from Columbus Air Force Base, Mississippi were dried overnight in an oven at 30 C, and then sifted through a 2 mm sieve. The samples that were over 2 mm were placed in a separate plastic

Figure 1



y
N
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multilevel sampler
injection well
BarCad
BarCad and flowmeter test
piezometer
Inset
injection point
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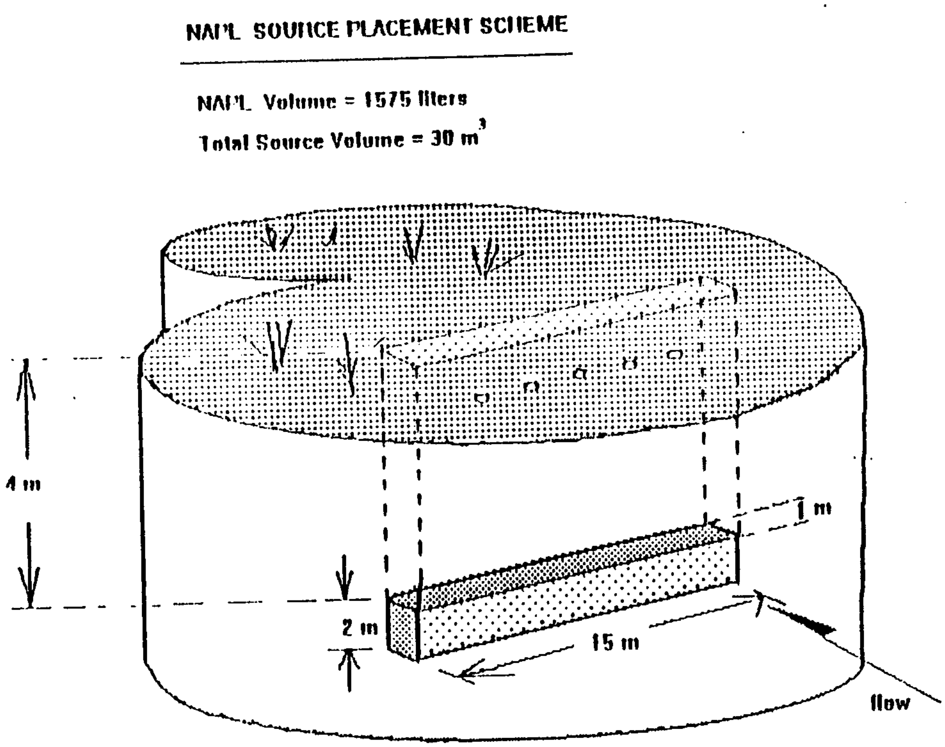
Figure 2



NAPL SOURCE PLACEMENT SCHEME
NAPL Volume = 1575 liters
Total Source Volume = 30 m³
4 m
1 m
2 m
15 m
flow

bag and stored for use in other analysis. Samples that were greater than 2 mm and less than 2 mm were weighed so the particle size distribution can be determined.

Sample preparation

The samples used in the carbon determinator were saturated with 1N HCl and dried overnight in an oven set at 30 C. Ten replicates of soil were run by weighing roughly one gram of soil, and adding one scoop of copper metal accelerator.

Analysis

Three blanks were prepared for the carbon determinator, for each sample, by placing one scoop of copper metal accelerator in each of the crucibles. Three calibration standards were also prepared by placing one scoop of copper metal accelerator and one carbon and sulfur steel ring in each of the crucibles. Calibration checks and check standards were run as quality control. Standard deviations were not accepted if they were over 25%, however, due to instrument failure, several soil samples will be reanalyzed when parts are received for repair.

Results

The total organic carbon analysis that was run on the samples demonstrated expected results that compare to earlier studies (Table 1). The total organic carbon frequency distribution (as is shown on a histogram-Table 2) has a log normal distribution as is common among geochemical parameters. The averages for all of the carbon percents equals .084507. The values fall between the ranges of .009400 and .593130.

Conclusions

The results that were collected appear to be useful, they correlate with previous studies and will be helpful in the natural attenuation study as a whole. Total organic carbon percent is just a fraction of this study which will proceed on.

Table 1

CM3 D1			CM3 D2			CM3 D3		
	Mass (g)	TOC%		Mass (g)	TOC%		Mass (g)	TOC%
1	1.0013	0.0946	1	1.0007	0.0403	1	0.9994	0.026
2	1.0005	0.1002	2	1.0013	0.0328	2	1.0029	0.0281
3	1.0006	0.0957	3	1.0053	0.028	3	1.0016	0.024
4	1.0018	0.1075	4	0.9996	0.0317	4	1.0008	0.0235
5	1	0.0847	5	1.0004	0.0423	5	0.9992	0.0211
6	1.0013	0.0963	6	0.9998	0.0309	6	1.0004	0.0236
7	1.0009	0.1005	7	1.0015	0.0325	7	1.002	0.0226
8	1.0002	0.1044	8	1.0009	0.0313	8	1.0003	0.0242
9	1.0007	0.1079	9	1.002	0.0366	9	1.0014	0.0239
10	1.0013	0.1209	10	0.9999	0.0375	10	0.9997	0.0232
	Std dev-1	0.009743		Std dev-1	0.00457		Std dev-1	0.001894
	Mean	0.10127		Mean	0.03439		Mean	0.02402
	Std dev %	9.62		Std dev %	13.29		Std dev %	7.89
CM3 D4			CM3 D5			CM3 D6		
	Mass (g)	TOC%		Mass (g)	TOC%		Mass (g)	TOC%
1	1.0019	0.0216	1	1.001	0.0215	1	1.0027	0.0536
2	0.9997	0.0358	2	1.0011	0.0368	2	1.0011	0.0527
3	1.0011	0.029	3	0.9993	0.0346	3	0.9998	0.0475
4	0.9998	0.0285	4	1.001	0.028	4	1.0026	0.0715
5	1.0013	0.0282	5	0.9995	0.0446	5	1.0017	0.0784
6	1.0025	0.0313	6	1.001	0.0429	6	1.0013	0.0605
7	0.9996	0.0361	7	1.0025	0.05	7	1.0017	0.0547
8	1.0015	0.0265	8	1.0009	0.0373	8	1.0009	0.0605
9	1.0003	0.0298	9	1.0016	0.0357	9	1	0.0536
10	0.9997	0.0315	10	0.9996	0.0274	10	1.0006	0.0614
	Std dev-1	0.004267		Std dev-1	0.00863		Std dev-1	0.009367
	Mean	0.02983		Mean	0.03588		Mean	0.05944
	Std dev %	14.3		Std dev %	24.05		Std dev %	15.76
CM3 D7								
	Mass (g)	TOC%						
1	1.0008	0.0134						
2	1.0011	0.0153						
3	1.0001	0.008						
4	0.9994	0.0054						
5	0.9997	0.0093						
6	1.0005	0.0093						
7	1.0005	0.0055						
8	1	0.0121						
9	1.0002	0.0082						
10	1.0002	0.0075						
	Std dev-1	0.003272						
	Mean	0.0094						
	Std dev %	34.81						

CM6 D1			CM6 D2			CM6 D3		
	Mass (g)	TOC%		Mass (g)	TOC%		Mass (g)	TOC%
1	1.0007	0.1694	1	0.9997	0.0344	1	0.9995	0.059
2	1.0001	0.2084	2	0.9998	0.0305	2	0.9996	0.0777
3	1	0.2322	3	0.9997	0.0272	3	1.0008	0.0897
4	1.0006	0.3691	4	0.9995	0.0269	4	1.0006	0.0866
5	1.0008	0.2458	5	1.0001	0.0293	5	1	0.0792
6	1.0007	0.2204	6	1.0004	0.0309	6	0.9999	0.0887
7	1.0006	0.2312	7	1.0002	0.0269	7	1.0001	0.0925
8	0.9999	0.2395	8	1	0.0411	8	0.9999	0.0737
9	0.9996	0.2245	9	1.0002	0.0337	9	0.9993	0.0747
10	1.001	0.2439	10	1.0007	0.0266	10	1.0009	0.665
	Std dev-1	0.051		Std dev-1	0.0046		Std dev-1	0.01082
	Mean	0.23844		Mean	0.03075		Mean	0.07883
	Std dev %	21.39		Std dev %	14.97		Std dev %	13.73
CM6 D4			CM6 D5			CM6 D6		
	Mass (g)	TOC %		Mass (g)	TOC %		Mass (g)	TOC %
1	1.0008	0.0724	1	0.9996	0.0492	1	1.0002	0.0045
2	0.9999	0.0623	2	0.9993	0.0291	2	1.0002	0.0105
3	1.0003	0.0845	3	1.0004	0.0338	3	0.9993	0.0121
4	1.0006	0.1187	4	1.0008	0.0431	4	0.9998	0.0079
5	0.9996	0.0756	5	1.0007	0.0681	5	0.9995	0.0114
6	1.0007	0.0829	6	1	0.0498	6	0.9997	0.0099
7	1.0004	0.0837	7	1.0008	0.0422	7	0.9995	0.0082
8	1.0009	0.0827	8	0.9999	0.0341	8	1.0003	0.0126
9	1.0005	0.0726	9	1.0002	0.04	9	0.9997	0.0118
10	1.0008	0.0744	10	1.0001	0.0442	10	0.9997	0.0119
	Std dev-1	0.01496		Std dev-1	0.01096		Std dev-1	0.00254
	Mean	0.08098		Mean	0.04336		Mean	0.01008
	Std dev %	18.47		Std dev %	25.28		Std dev %	25.2
CM6 D7								
	Mass (g)	TOC %						
1	1.0009	0.0073						
2	0.9991	0.0104						
3	1.0007	0.0122						
4	0.9999	0.0101						
5	1.0004	0.0107						
6	0.9997	0.0113						
7	1.0009	0.0099						
8	0.9995	0.0068						
9	0.9993	0.0088						
10	0.9992	0.0084						
	Std dev-1	0.001734						
	Mean	0.00959						
	Std dev %	18.08						

CM9 D1	Mass (g)	TOC %
1	1.0004	0.5271
2	0.9991	0.6058
3	1.0006	0.5899
4	0.9998	0.584
5	1.0005	0.6253
6	1.0007	0.6294
7	0.9991	0.6174
8	1	0.6118
9	1.0003	0.6175
10	0.9997	0.5231
	Std dev-1	0.03859
	Mean	0.59313
	Std dev %	6.51

CM9 D2	Mass (g)	TOC %
1	0.9992	0.1752
2	1.0001	0.0796
3	0.9996	0.0956
4	0.9999	0.1316
5	1.0007	0.1925
6	0.9999	0.1355
7	1.0009	0.1278
8	0.9997	0.2866
9	0.9998	0.0772
10	1.0003	0.1825
	Std dev-1	0.06359
	Mean	0.14841
	Std dev %	42.85

CM9 D3	Mass (g)	TOC %
1	0.9992	0.1008
2	0.9994	0.0801
3	1.0006	0.1811
4	0.9998	0.0804
5	1	0.0735
6	1.0008	0.0747
7	1	0.1227
8	0.9993	0.0692
9	1.0008	0.0774
10	1.001	0.0649
	Std dev-1	0.0355
	Mean	0.09248
	Std dev %	38.39

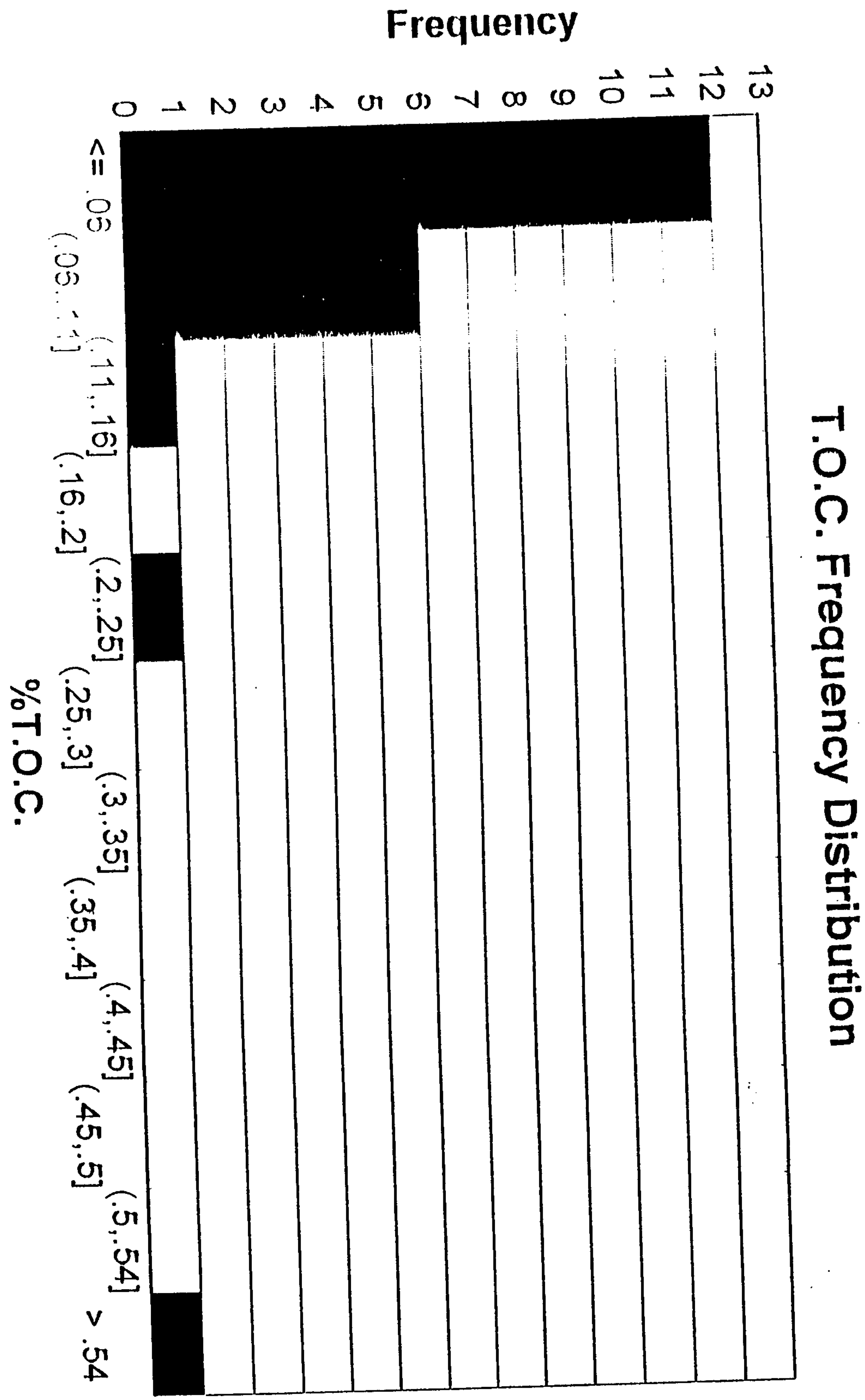
CM9 D4	Mass (g)	TOC %
1	1.0008	0.0244
2	0.9996	0.0278
3	0.9995	0.0226
4	0.9995	0.0308
5	1.0008	0.0345
6	0.9994	0.0539
7	1.0007	0.0256
8	1.0001	0.0362
9	1.0007	0.0282
10	1.0007	0.0258
	Std dev-1	0.009142
	Mean	0.03098
	Std dev %	29.51

CM9 D5	Mass (g)	TOC %
1	1.0004	0.0337
2	1.0009	0.0451
3	1.0007	0.0371
4	0.9999	0.0387
5	1.0006	0.0291
6	1.001	0.0349
7	1	0.0376
8	1.0001	0.0359
9	0.9991	0.0361
10	1.001	0.0404
	Std dev-1	0.00422
	Mean	0.03686
	Std dev %	11.44

CM9 D6	Mass (g)	TOC %
1	1.0005	0.0601
2	1	0.081
3	1.0005	0.0585
4	1.0001	0.081
5	1.0002	0.0658
6	1	0.0652
7	1.0003	0.0544
8	1.0007	0.0351
9	1.0003	0.0582
10	0.9997	0.117
	Std dev-1	0.02221
	Mean	0.07036
	Std dev %	31.57

CM9 D7	Mass (g)	TOC %
1	1.0007	0.0125
2	1.0005	0.0354
3	1.0007	0.0121
4	0.9999	0.0159
5	1	0.012
6	0.9998	0.0139
7	0.9996	0.0126
8	1.0001	0.0198
9	1.0002	0.0146
10	1.0007	0.0128
	Std dev-1	0.007166
	Mean	0.01616
	Std dev %	44.34

Table 2


T.O.C. Frequency Distribution
Frequency
0
1
2
3
4
5
6
7
8
9
10
11
12
13
<= .05
(.05,.11]
(.11,.16]
(.16,.2]
(.2,.25]
(.25,.3]
(.3,.35]
(.35,.4]
(.4,.45]
(.45,.5]
(.5,.54]
> .54
%T.O.C.

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NETWORK CONSIDERATIONS

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Air Force Civil Engineering Support Agency

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August 1994

NETWORK CONSIDERATIONS

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Abstract

The question of whether to put software applications on the network or on the client computer was studied. Situations were examined, and more questions arose than answers. How many users needed the application became an important question. Other areas that were considered were administration, economics, and performance. It was determined that each application and site should be considered separately.

NETWORK CONSIDERATIONS

Christopher S. Protz

Introduction

As large networks become more common and start to appear in small offices as well as in large corporations, the question of how to administer networks becomes more and more important. This project was concerned with one aspect of administration, where to put applications. Applications placed on the network may cause a decline in performance of the network and the individual workstation by using too much bandwidth, while applications placed on individual systems are harder to maintain because updates have to be administered on each individual computer rather than in one central location (the server). This is one of the many pressing questions that are surfacing with the rise of networking and the client-server network.

Discussion of Problem

Many considerations need to be taken into account when starting a computer network. How much speed and therefore what type of network infrastructure does the network you're building need? What type of cable is necessary? Which network operating system (NOS) should be used? How fast does the server need to be? What type of operating system is the server going to run on? What companies should you buy the network cards, hubs, servers, etc. from? What type of management utilities are you going to need to administer the network? The possibilities are limitless. This project was primarily concerned with the question of where to put applications. Should they be located on the network side or on the client side? This question must be answered when building a client-server network.

Client-server networks are networks of personal workstation computers linked to powerful computers called servers. Servers have multiple functions. They provide a large amount of disk space, which is shared by all users, and high speed processing, which is necessary to handle the multiple users that will be logging onto the system. Servers also provide a means to connect all the users together. Users are people who use the personal workstations to connect to the servers. Workstations are the individual computers that each client uses to reach the network, communicate with other users, and accomplish tasks.

The three aspects of client-server application placement that were considered in this project are the performance of the network and the individual workstations, the amount of administration, and the economics and total cost of each of the possibilities. Performance deals with the overall speed of the network and the wait time for the end users trying to use the applications. This involves the amount of bandwidth needed to transfer information and the time the server has to spend executing programs and applications. Administration refers to the difficulty of managing and updating a network. Economics is the overall price of the applications and the administration needed for them. The cost of the applications is based on where they are located.

Methodology

Many methods were used to accomplish this project. The most used method was to consult experienced network administrators and other people that have a lot of experience in the area of network performance. Although no ideal network with uniform traffic can ever be created to test all possible placements of the applications, many performance tests were performed on the newly installed network at the Air Force Civil Engineering Support Agency. Because of the many variables involved in networks and networking nothing exact could be determined from these tests, but much could be extrapolated from them by experienced network administrators.

Results

When this project was initially started, we thought that there would be one answer. We would either put the application on the server, or on the client. However, we found out that each application has to be considered differently.

Conclusions

We found that each application has to be considered in terms of cost, manageability, and performance aspects. Each network installation is different, and therefore has its own needs and limitations.

The performance of the application on the network has to be considered. Small programs that don't take up much bandwidth can easily be put on the network if many different users need them. Large programs have to be examined closer because of their bandwidth consumption. Questions such as how they will effect the speed of the network as a whole, how many users will need the program, and how fast the users will need the programs to run need to be considered when adding larger programs to the network. Programs that reach out to the network or other networks will obviously have to go through the network at some time and take up network bandwidth and therefore should be placed on to the server in most cases. Only when the program is very large and very few users are going to use it should it be put on the workstation. Although these applications should be put on the server in most cases, access to these resources should be limited by the administrators, so that the network does not become clogged with traffic. This is also a question based on the capabilities of the network. If the network is limited by disk space, then large applications would have to be put on the client side. Also some networks are inherently faster than others because of the hardware used, so the performance issue has to be evaluated for each site.

Administration is another concern. If all applications are on the server, updates and problem solving are made much easier because there is one individual location to change and modify applications and look for problems. Plus many application specific causes for problems can be eliminated if only one user on the network is having problems. The problem is obviously outside of the application if another user is not experiencing any problems running the same application from the same place on the network. If all the users are having problems with the same application then it is obvious that there is a problem with the application on the network and not something wrong with each individual workstation. Updates are also a large problem if many applications are put on the individual workstations. One person could not update every PC every time any of the applications needed to be updated. More administrators would be needed to maintain the network if most of the applications were placed on the individual workstations. This would greatly increase the cost of controlling and maintaining the network. The cost of administration is another concern. Many sites cannot afford more than two or three administrators. With so few administrators, it would be impossible to support every application on every computer.

The cost of the application is another concern. An individual copy for each client could become very costly. Licenses would still be needed for each client that would use the application from the network, but the cost would be much less. Also many programs offer site licenses in which the program can be put on the server and used by all clients. The other option is counters. A site could have for example five licenses for an application. With a counter, only five clients would be able to use the application at a time. This cuts down costs greatly if the application is for a few users only. Also this makes workstations upgrades a lot easier because you do not have to move the application between hard drives. The application will be there for the user no matter what workstation the user logs in on.

Each application is different. Not only does the application have to be considered, but the limits of the system, the cost, and the manpower needs have to considered for each application.

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THE LEARNING OF HYPERBARIC MEDICINE

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Final Report for :
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Armstrong Laboratory

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THE LEARNING OF HYPERBARIC MEDICINE

Rebecca J. Scheel

Abstract

The summer on Brooks Air Force Base, San Antonio, Tx., was spent learning about the backbone functions needed to run a hyperbaric medicine clinic. Aspects such as clinical care, experimentation, and administration were encountered. There was no understanding of this division of Aerospace Physiology when the term began but a comprehensive knowledge was acquired over the course of the eight weeks.

THE LEARNING OF HYPERBARIC MEDICINE

Rebecca J. Scheel

Introduction

Hyperbaric Medicine has been around for several decades, but it has been over the past decade or two that hyperbarics has come into a new light, exposing itself, and showing people just how important it really is. It is used not only for treating decompression sickness but also in the clinical aspect of treating patients with osteomyelitis or patients with diabetes who have ulcers or wounds on the extremities of their body from lack of sensation. Hyperbaric oxygen therapy has been found to assist in the healing process by helping the oxygen flow to areas of the body where there is a hindrance of the body's natural healing instinct.

Duties and Processes

Clinical care was not the only feature of hyperbaric medicine the was met during the eight week term. There are a lot of facets of a business that must be attended to. The opportunity to help with administration aspects arose.

Keeping accurate records is an important part of health care administration. Each patient must be able to come back in ten years and ask any question about their treatment and have it answered.

Therefore an efficient record system must be maintained, and added to if necessary. You also needed several reference points for every one patient so multiple copies must be preserved and updated when required. There is the problem of the Privacy Act Statement guaranteeing each patient confidentiality of their file unless released with their permission. There were many legal aspects that needed to be paid close attention to so that each person had their consitutional rights but had the best care available.

Patient records were not the only ones that needed constant maintenance. A record of each treatment dive must be kept with the appropriate code, and each inside observer must have proper recognition. Receiving pressurized oxygen, or undergoing a hyperbaric dive, should not be done more than once in a twelve hour period, because it has been found to have adverse affects on the body stemming from problems with getting the nitrogen to reabsorb into the blood stream. Usually there were two to three dives a day but later in the summer we sent down up to five or six using up every possible person to dive for the day.

The reason the amount of dives increased is that experimentation dives were occurring in a separate chamber from the patient dives and at different times. Subjects, white rats genetically identical to one another, were taken down to a depth of 135 feet, compared to the usual 45 feet, and given one hundred percent oxygen. Different subjects had been given different foods, some absent of nitrogen, to try to connect the seizures that occur under pressure with a nutrient that is produced and ingested in the human body, thought to possibly be nitrogen. Normally the human body can only take up to a half hour of pressurized oxygen at a time, and then they need outside air for ten minutes to allow their body to continue with some of its natural processes. These experiments were done to see if it was possible to increase treatment time without causing adverse affects in the patients. While these experiments were being held numerous research projects were being done to build a foundation for whatever the results might be.

Closure

Overall, a comprehensive understanding of hyperbaric medicine was sought and found. Some idea of the complexity of running a business, let alone one in the health care business, was gained, and an affirmation of a future career in the health field was acquired.

THE DETERMINATION OF LEAD IN PAINT CHIPS

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THE DETERMINATION OF LEAD IN PAINT CHIPS

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Abstract

This report descibes the procedure used at the Brooks AFB Occupational and Environmental Health Laboratory to determine the lead content of paint samples. This procedure consists of two main phases: digestion and analysis. Analysis of the paint sample is performed using a Perkin-Elmer Model 303 atomic absorption spectophotometer. Because this instrument can only analyze liquids, the paint chip must be processed into liquid form, or "digested." The resulting sample can then be run through the instrument and analyzed. Both phases will be detailed in this paper.

THE DETERMINATION OF LEAD IN PAINT CHIPS

Tina K. Schuster

Introduction

It has been known for many years that lead and lead compounds can be highly toxic when eaten or inhaled. The nervous, urinary, and reproductive systems are most susceptible to damage from lead overexposure {3}. The extreme result of lead poisoning is death.Young children are the primary victims of lead poisoning because oftheir proximity to the floor and frequent hand to mouth behaviors. In 1984, the Agency for Toxic Substances and Disease Registry estimated 17 percent of all American preschool children had blood lead levels exceeding the amount considered safe {1}. The growing concern over the effects of lead poisoning has prompted the American government to take regulatory actions. The Lead Based Paint Hazard Reduction Act of 1992, Title X, requires the Environmental Protection Agency to define lead contaminated paintby April 1994 {1}. As a result, laboratories across the nation must utilize the most accurate and timely methods of testing these samples.

Methodology

The method of determining lead in paint chips consists of two phases: digestion and analysis. The digestion process begins with weighing out .1 grams of a dried paint chip into a 100 milliliter beaker. Twenty milliliters of a reagent grade nitric acid/distilled water solution are added to the beaker, which is then placed on a heating plate. When the acid heats up, it will dissolve the paint chip. The mixture is "cooked" down to approximately five milliliters before it is removed from the hot plate. Once the sample cools, it is filtered into a 15 mL centrifuge tube so that only the liquid components are left from the paint. The rest of the tube is filled with distilled water from a Millipore system. The paint sample is then ready to be analyzed by flame atomic absorption spectrophotometry. The Perkin-Elmer Model 303 operates under the following conditions: wavelenth 218 nm; slit 4; lead hollow cathode lamp; air acetylene burner (0.5X 110 mm slit) with supply of air at 60 psi and acetylene at 10 psi for an aspiration rate of 0.8 ml/minute {4}.

Results & Conclusion

The results of this type of analysis are used to identify paints that may pose a potential hazard. The Department of Housing and Urban Development's abatement criteria is 1.0 mg per square centimeter or 0.5% by weight {2}. The atomic absorption method described in this paper allows for a quantitative determination of lead in areas where limits for human exposure are exceeded. This data aids bioenvironmental engineers in conducting proper removal operations.

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PREDICTING PERFORMANCE IN REAL-TIME TASKS

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August 1994

PREDICTING PERFORMANCE IN REAL-TIME TASKS

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ABSTRACT

This study investigates the correlation between driving simulator performance and Cognitive Abilities Measurement (CAM) tests of spatial working memory and spatial processing speed, and the correlation between simulator performance and average speed in the simulator. Subjects took a week long battery of cognitive abilities tests, which included the spatial working memory and spatial processing speed tests. Subjects also took a fifteen minute driving simulator test. Results showed non significant correlations between driving simulator performance and the CAM spatial working memory and spatial processing speed tests. Results did show a significant correlation of 0.48 between simulator performance and average speed in the simulator, suggesting that driving speed affects driving performance. In addition, the mean average speed for males was significantly higher than for females, suggesting that males are more risky drivers than females.

INTRODUCTION

OBJECTIVE

This research was concerned with establishing whether spatial processing speed and spatial working memory scores can predict performance in real-time tasks, in particular a driving task. *Real-time tasks* involve coping with a continually changing situation or situations. Important aspects of real-time tasks include rapid decision making and coordinating several tasks at the same time. For instance, a driver in a car wishing to access the freeway, would have to coordinate accelerating on the ramp and steering onto the highway, while deciding when it would be appropriate to do so. Other real-time tasks would include flying, air-traffic control, and sailing.

Driving performance was measured with a high fidelity driving simulator with auditory and visual feedback. The simulator was equipped with standard American car controls including steering wheel, key, gas, brake, and clutch. Cognitive tests of spatial processing speed and spatial working memory were also administered.

RELATED RESEARCH

Tirre, Koonce, and Raouf (1994) showed that working memory ability and processing speed could predict performance in a flight simulator. Their research "was designed to investigate how flying skill acquisition might be predicted by aptitude factors under laboratory conditions using BFITS [Basic Flight Instruction Tutoring System] as the criterion." (p. 2). Cognitive ability tests and simulator tests were administered. Results showed a correlation of about 0.2 to 0.4 between working memory ability and performance in the simulator, and a correlation of about 0.3 between processing speed and simulator performance. The two cognitive ability tests, working memory and processing speed, were composites of verbal, quantitative, and spatial scores.

In this study, subjects were administered a subset of the cognitive ability tests used by Tirre et al. (1994), in particular the spatial working memory ability and spatial processing speed tests. Subjects also operated an Atari driving simulator and their performance was evaluated on their ability to cope with situations encountered therein.

Subjects with better spatial working memory abilities should be more cognizant of objects in each particular situation, allowing the subject to cope better in the simulator. Similarly, subjects with faster spatial processing speed should become cognizant of situations faster allowing more time to choose better means of coping with situations . Thus both spatial processing speed and spatial working memory were expected to correlate with performance in the simulator.

METHODOLOGY

SUBJECTS

Twenty-two (thirteen male and nine female) individuals were randomly selected from a pool of sixty temporary employees. The temporary employees were paid five dollars per hour, ranged from the age of eighteen to thirty years old, and have a high school diploma or equivalent. In addition, all the participants in this experiment had a valid driver's license.

COGNITIVE ABILITY TESTS

All of the subjects received a week-long battery of tests, from the Cognitive Abilities Measurement (CAM) battery (Kyllonen, P. C., Christal, R. E., 1988). These included the spatial processing speed and spatial working memory tests. The tests were administered on personal computers with a color monitor display and a mouse for subject responses. Each of the spatial working memory and spatial processing speed tests appeared in two versions with similar or identical trials.

Spatial Processing Speed Tests

Two term ordering - Blocks : A pictorial statement describes the spatial arrangement of two blocks. The subjects are to determine whether another picture represents that spatial arrangement.

Verification - Synthesis Add : In this test, subjects must quickly decide if combining the first two figures presented would result in the third figure.

Single Opposites - Opposite Matrix Square : Subjects are required to determine as quickly as possible whether two figures are alike and whether two figures are opposite; according to the color they are printed (i.e., white or red, respectively).

Spatial Working Memory Tests

Four term ordering - Blocks : In this test three pictorial statements, displayed one at a time, describe the spatial arrangement of two pairs of square blocks. Subjects are to choose the appropriate spatial arrangement from a selection of eight.

Verification - Synthesis Add + Matrix : In this test subjects must memorize a sequence of individually presented three by three matrices, each with one area shaded in. The sequence is interrupted by items similar to the verification spatial processing speed test.

Continuous Opposites - Subjects are presented with a series of three by three grids with one area shaded in. Subjects are to recall the last three matrices or their opposites, depending on the color of the shaded area.

SIMULATOR TEST

Apparatus

The high fidelity Atari driving simulator follows a basic interior car design for the driver. Controls include gas and brake pedals, clutch, steering wheel, gear shifter. The display consists of three 20" monitors, one forward monitor facing the driver, and two side monitors angled obliquely from the driver allowing some forward and lateral vision. Objects in the simulator are low resolution and have few colors. The clutch was disabled so that gear shifting would be automatic, since not everyone knows how to use a standard transmission.

Practice Course

The subjects first drove through a fifteen minute practice course, which served to familiarize them with the car handling procedure, allow them adjust to the simulator environment, and expose them to some situations similar to what they might find in the actual test.

Test Course

The fifteen minute test course was similar to the practice course, but contained more situations. Instructions to turn were displayed in the upper portion of the center monitor as needed. The test course contained twenty-five hazardous situations and eleven non-hazardous situations (see definitions below). The non-hazardous situations appeared periodically throughout the course to reduce the suspicion given to each object, creating a more natural driving environment.

Hazardous situations are those situations that require special measures from the subject, as shown in the following examples.

> Example 1 : The driver approaches a side street intersection with all three traffic directions having stop signs. The driver is instructed to turn right instead of going straight. At the intersection though, a car is stopped obliquely in the road with its forward end in contact with the driver's stop sign such that the driver's lane is obstructed. An oncoming van is visible. The criterion to successfully cope with this situation is stopping in the right hand lane first, then driving around the stopped vehicle to make the right turn while not going off-road or colliding with another object.
>
> Example 2 : The driver is going up hill, and at the top of the hill is a barrier. The barrier obstructs only the driver's lane so that seeing what is on top of the hill is not possible. On top of the hill are two oncoming vehicles in the left lane. The criterion to successfully cope with this situation is going off-road to the right of the barrier, while not colliding with any objects.

Non-hazardous situations are those situations that do not require special measures from the participant to cope with, as shown in the following examples.

> Example 1 : An on coming car is driving in the left lane, with no other objects in the area.
>
> Example 2 : A car is stalled on the side of the road, with no other objects in the area.

PROCEDURE

During the week of cognitive test administration, subjects were selected at random times to take the simulator test. The subjects were asked to maintain a speed of around forty miles per hour as best as they could and stay in the right hand lane of the two lane highway. Subjects could speed up, slow down, and go off-road or into the left hand lane as necessary to cope with a situation. The subjects first drove for fifteen minutes in a practice run. Then the fifteen minute actual test was administered.

RESULTS

SCORING

The percent items correct for each cognitive ability test were taken and z scores calculated. Then for each subject, the spatial working memory z scores and spatial processing z scores were averaged to get a single spatial working memory score and a single spatial processing speed score, respectively. For simulator performance, A percent failure (i.e. percent of hazardous situations failed) was determined for each of the subjects based on the criterion for each situation. Also, for each subject the average speed for all speeds faster than ten miles per hour was calculated. The filter on speed was designed to eliminate instances where the drivers were thrust backward (with negative speed) after a collision, resetting themselves on the road after a collision, or waiting at a stop sign. It is likely that other instances where subjects traveled less than ten miles per hour would not be significantly different among subjects.

CORRELATION BETWEEN SIMULATOR PERFORMANCE AND COGNITIVE TESTS

Percent situations failed in the simulator had non significant correlations (Pearson's r) of -0.05 with spatial processing speed ($p = 0.81$) and of 0.11 with spatial working memory ($p = 0.62$).

CORRELATION BETWEEN SIMULATOR PERFORMANCE AND AVERAGE SPEED

Percent situations failed in the simulator did have a significant correlation (Pearson's r) of 0.48 with average speed ($p = 0.02$), as shown in figure 1.

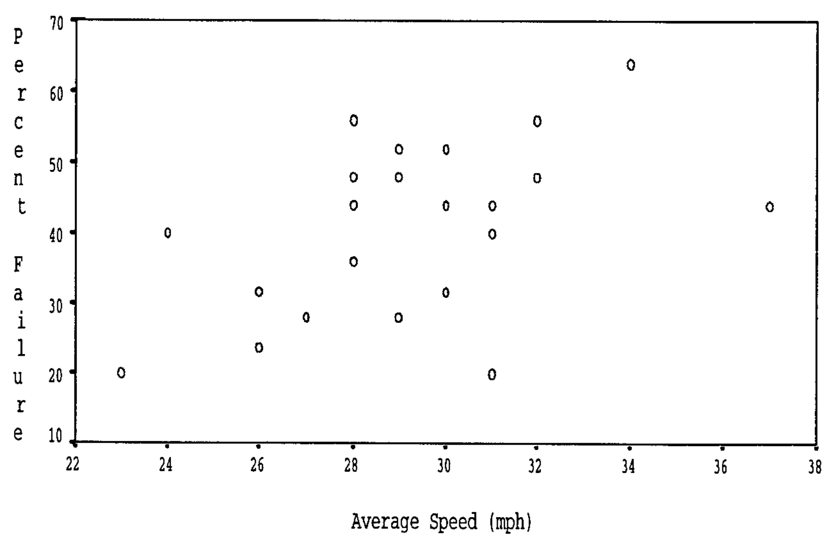

Figure 1
Simulator Performance Versus Average Speed

Gender Comparisons

The mean speed for males, 30.6 mph, was significantly greater than that for females, 27.2 ($t(20) = 2.89$, $p < 0.01$).

DISCUSSION

Cognitive and Simulator Tests

Results showed no significant correlation of simulator scores with spatial working memory. The hazardous situations in the simulator made low demands on spatial working memory. In most situations the driver had to pay attention to only two to five objects, and there were no important instrument displays, since subjects were instructed that maintaining a speed of forty miles per hour was low priority in hazardous situations.

Similarly, low demands on reaction time may have accounted for the lack of correlation of performance in the simulator and spatial processing speed. In most situations, the driver could stop to evaluate the situation, taking as much time as necessary.

In contrast Tirre's, Koonce's, and Raouf's flight simulator required coordinating multiple display information with objects in the simulator, where subjects had a limited amount of time to make decisions, thus placing higher demands on spatial working memory and spatial processing speed, respectively.

Simulator Tests and Average Speed

Average speed and simulator scores showed a significant correlation of 0.48. This may be important in training driver's by providing a means of demonstrating the consequences of fast driving using the trainee's actual performance relative to that of other trainees.

Gender Comparison

The mean average speed for the male participants was significantly higher than for the female participants even though both groups were given identical instructions to maintain a speed of forty miles per hour as best as they could. Although there was a significant correlation between simulator scores and average speed, neither group showed significantly better simulator scores, spatial working memory scores, or spatial processing speed scores.

CONCLUSION

Based on the correlation of average speed and simulator scores, it is evident that higher speeds make coping with situations similar to those in the driving simulator more difficult. Results also showed that males have a tendency to drive faster than females, suggesting that males are more risky drivers.

ACKNOWLEDGMENT

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THE COMBUSTION OF ADVANCED COMPOSITE MATERIALS

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FINAL REPORT FOR:
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THE COMBUSTION OF ADVANCED COMPOSITE MATERIALS

RYAN Q. SIMON
The Combustion of Advanced Composite Materials

ABSTRACT

The burn characteristics of Advanced Composite materials were investigated. The object of the study was to find particle diameter, smoke composition and the relationship between area, heat and mass loss. Product gasses were analyzed and compounds identified using a Fourier Transform Infra Red (FTIR) spectrometer. Particle size was measured using a high powered optical microscope, and was determined to be less than two microns. This was later verified by electron microscopy. The FTIR discovered many compounds in the smoke, most of which were phenol and aniline derivatives. Data was collected using the controlled environment of the UPITT II oven system. The UPITT II was based on an original design pioneered by the University of Pittsburgh and later enhanced by the United States Army. Data was collected using two configurations of the UPITT II system.

INTRODUCTION

Although the study has not been completed, enough has been done so that a detailed account of what I accomplished can be related. I aided in the data collection of a combustion/toxicology study that involved Advanced Composite Material (ACM), which is used in the outermost skin of various aircraft. These particular ACM samples were provided especially for our study and are of the same type of composite that is used on the B-2 Bomber. The skin is composed of tightly woven carbon filaments held together and given strength by an epoxy.

Both the Air Force and the Army are interested in the results of this study. The Air Force is concerned with the toxicity of the products created while the composite is burning and would assess the toxicity of the gas products released by the burning composite. The Army is assessing the composite for possible use in their Composite Armored Vehicle (CAV). They have not determined which is the best candidate material but this ACM is a possibility.

In the study coupons of various sizes were burned at varying temperatures and air flows. These conditions were used to simulate the crash of an aircraft. Coupons of various sizes allowed us to observe the mass loss and plot it accurately. This would enable investigators to estimate the amount of composite burned in a certain crash and predict the amount of gaseous products. Different temperatures and airflows allowed us to simulate different combustion conditions and air speeds, as well as enable us to determine the relationship between the variables and mass loss.

Data was collected using two methods. In both methods the coupons were burned under controlled conditions using the UPITT II system. In the first method , the smoke byproduct was directed through an air sampler and the smoke was analyzed for composition. In the second method, smoke was through a large pipe where particle settling was measured.

METHODOLOGY

To begin the experiment the composite material was cut into the proper sizes, coupons of 2"x 2", 4"x 4", and 6"x 8". Data was then collected using the two separate burn methods, the UPITT II method and the modified UPITT II method which involves a tunnel.

In the first method, the UPITT II method, burns were ten minutes long. Temperature and airflow were varied to obtain our data. Three burns occurred at each of five different airflows, 19.6, 27.7, 35.6, 41.5, 52.3 (L/min.) At each of these airflows, the temperature was either 625, 770 or 880 (degrees Celsius) over the three burns. Smoke and particulate were drawn through a series of stainless steel pipes and analyzed using two separate methods. In one analysis, smoke was drawn through a filter and ejected into the fume hood. The filter paper was then examined under a microscope where particle size can be measured. Filter samples were taken at select times during the ten minute burn. These stages were noted as the first sign of smoke, the first sign of flame, 3 minutes, 5 minutes, and 9 minutes. The second method of analysis was spectrometry. The smoke and particulate was drawn through Fourier Transform Infra Red (FIR) spectrometer. This instrument provided information on the contents of the smoke. It analyzed the smoke and identified the compounds that were in it.

In the modified UPITT. II method a sixty foot PVC pipe (12" diameter) was used. The same oven that was used in the UPITT II system was utilized in this system. The composite was burned in the oven under the same conditions as the previous portion of the experiment. Filters similar in design to the ones used in the previous portion of the experiment were also used in this part of the investigation. They were placed at intervals on the tunnel in a ring along the curve of the tunnel. The smoke was drawn through the tunnel at 1190(L/m). We were able to test particle settling by placing studs in the bottom of the tunnel at the same intervals as the filters. These studs collected the particulate as it fell to the bottom of the tunnel. Smoke was exhausted out the back end of the tunnel, cleaned in a scrubber and evacuated into the fume hood.

All parts that came in contact with the smoke were stainless steel and were cleaned in acetone after three to four burns.

RESULTS AND CONCLUSIONS

We accomplished several of our goals in the process of our investigation. Analysis of the smoke using the FTIR helped us to determine what compounds were generated when the composite is burned. A list of the compounds is presented on the following page. Most of the compounds are phenol and aniline derivatives. Using the microscope, the particle diameter was determined to be approximately 0.12-5 microns. The mass loss rate also suggests a linear relationship between the area and temperatures. It was concluded that any personnel working in the vicinity of the burning composite should wear the proper respiratory protection.

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APPENDIX A

The following is a list of the compounds identified by the FTIR.

2-Methylpyridine
Benzennthiol
Aniline
Benzonitrile
Phenol
2-Methylaniline or Cresol
4-Methylaniline
Napthalene
Benzo[c]thiophene
Isoquinoline
Quinoline
2-Methylquinoline and/or 2-Methylnapthalene
3-Methylquinoline
5-Methylquinoline
Biphenyl
Diphenyl Ether
2-Nitro-1, 1'-biphenyl1,1',1"-(1-Ethanyl-2-ylidene)trisbenzene
1,5-Dimethylnapthalene
1,2-Dihydro-2,3,4-trimethylquinoline
2-or3-Phenylpyridine
2,5-Dimethylfurandicarboxlic Acid
1,1'-Biphenyl, 2-Diamine
1-(2,4,6-Trihydroxyphenyl)-ethanone
2,4,4,6-Tetramethyl-1,8-napthyridine
1,2,3,4,-Tetrahydrophenanthrene
2-Ethyl-1,1'biphenyl
7,8-Diphenylbicyclo[4.2.1]nona-2,4,7-triene
1,2,3,4-Tetrahydro-4methyl-4-phenanthrene

Molecular Modeling and Editing of DALM Halides

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MOLECULAR MODELING AND EDITING OF DALM HALIDES

Kenneth B. Spears
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Abstract

A molecular computer model of diazoluminomelanin[1] (DALM) was loaded into a computational chemistry program. The halides of this molecule were to be substituted with halogen atoms to examine how the molecules form and shape would change. When all of the halides were replaced by Iodine, most of the biggest changes occurred.

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MOLECULAR MODELING AND EDITING OF DALM HALIDES

Kenneth B. Spears

Introduction

As computer technology has rapidly progressed, the applications for their scientific use have come from the dark ages to the future in a matter of years. With the more recent interest in molecular modeling, computational chemistry has taken a new direction. By using these programs, editing, simulation, and calculations of molecules can be done easier and faster.

In this particular modeling process, DALM was used. DALM is a polymer containing 3-amino-L-tyrosine which is codiatized with luminol.

Methodology

A model of DALM for the chemistry simulator was already prepared by Major Eric Holwitt. Each atom was given a 3-dimensional coordinate in space, was told what kind of atom it was, and what kind of bond it had with other atoms. After the model was setup and loaded in its computer generated environment, it could then be tested in many various applications.

The main application of the study was the Energy Minimizer, which computed the molecule's movements and shape changes through time as its energy was decreased.

Another application put to use was the Dynamics Simulation. This computed how the main properties of the molecule would react in real time. These properties consisted of the molecule's pressure, temperature, atom velocity, kinetic and potential energy, and other measurements of changes in the model.

Results

As halides of the DALM molecule were edited and changed, each variation was put to test in the Energy Minimization program. Most of the changes did not cause many various shapes as expected. This may have been caused by the hardware used, giving the program limitations so that it could not be used to its full extent. It did however show that when halides of the molecule were all replaced with just Iodine, the initial changes had more divergence than the other halogens.

One other replacement of the halides was of some interest as well. It consisted of replacing the outermost atoms of the molecule with large halogens, such as Iodine, and choosing smaller halogen atoms for replacement of the more central halides. This caused small bends in the angles of bonds connecting the rings of the DALM molecule.

Conclusion

Although the changes weren't as expected, there was some enlightenment in the finding of the computer's hardware and software capabilities. The hardware showed some difficulties that needed to be modified, but the software revealed its potential as it was used in more intricate experiments. I believe that the field of molecular modeling has some promising uses for the future of chemistry.

A STUDY OF THE VISUAL TESTS PERFORMED ON AIR FORCE PILOTS

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Final Report for:
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A STUDY OF THE VISUAL TESTS PERFORMED ON AIR FORCE PILOTS

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Abstract

The visual tests performed on pilots in the Air Force play a vital part in determining whether or not a pilot will be qualified for flying status. Pilots must have excellent eyes in order to retain their vision under strenuous conditions. Continual observation was done to fully understand the method for performing certain tests. Further research was done to determine the possible defects the eyes might have based on the results of the visual tests.

A STUDY OF THE VISUAL TESTS PERFORMED ON AIR FORCE PILOTS

Courtney Ann Sprague

Introduction

Although computers and the field of technology have taken over much of the responsibility of flying, the eyes of the pilot are still vital in maneuvering the air craft. A military pilot must have exceptional visual senses in order to be permitted to fly any sort of air craft. A pilot must go through a series of tests which help determine the quality of his or her eyes. The pilot must pass all of the tests, or their position as a pilot is terminated, or they must continue to be re-evaluated. The tests performed on the pilots check their color vision, depth perception, visual field, refraction, and measure the contour of the surface of the eye.

Color Vision

Color vision is the "perception of color, results from stimulation of the red, green, and blue cone receptors in the retina" (Cassin 68). The ability to distinguish between colors is necessary for pilots because during times of combat, the pilot must be able to determine by sight which air craft belongs to the enemy. Similar air craft that varies only by symbols or colors would not be identified by a pilot with poor color vision. The basic operation of the air craft involves the ability to distinguish between colors. Color deficiency degrades even the basic skills of a pilot, and he or she could easily be out maneuvered by the enemy.

There are a variety of methods that can be used to test a pilot's color vision. One of the most common tests is the Farnsworth D100. This test is performed by having the pilot arrange "86 colored discs according to hue, divided into four separate hue panels" (Cassin 107). The hue is the appearance of color that gives it its name. For instance, a pilot may be asked to arrange a number of discs that are many shades of red from the lightest to darkest color. Failure to correctly arrange the discs is a sign that the pilot may suffer from a deficiency of erythrolabe, the red-sensitive pigments in the retina. This defect in the eye may be the result of deuteranomaly, a color vision deficiency mildly affecting red-green hue discrimination. This defect is commonly referred to as red-green color blindness. Protanomaly is another possible defect that is associated with a lack of erythrolabe. A person can suffer from a number of different types of color blindness. Shades of blue may be distinguishable while shades of red seem to be all one color, or vise versa. This is because color is distinguished by three different cones. The eye may successfully create one type of cone, and not another.

Depth Perception

Depth perception is the "ability to perceive the solidity of objects and their relative position in space" (Slatt 25). Depth perception is extremely important to all pilots because almost all types of flying require the ability to recognize depth. Without good depth perception, pilots could not "judge distances, estimate the size of objects, or avoid bumping into things" (24). This could cause the pilot to smash into an object even before he or she could realize the object was close. Without depth perception, even the most simple tasks become difficult.

Depth perception can be tested in a visual screening device. In this test, the pilot looks into a stereoscopic viewer and points out the image that appears to be further away than the other images. This is a binocular test since one can not have stereopsis with only one eye. There are many other ways to test a pilots depth perception, and often more than one test is performed. This helps verify the results of the previous test.

Problems with depth perception can result from problems with the areas around the eye, or with the eye itself. The eye is responsible for sending images to the back of the brain, the occipital cortex. Defects in the retina-to-brain nerve pathway can change the brain-wave patterns. This distorts the way the brain perceives the image, and may cause the visual fields to not overlap properly. If the problem lies with the eye itself, then the eyes may be misaligned. This prevents each eye from viewing the same object of regard. When this occurs, the pilot may experience diplopia (double vision), or one eye will completely shut off(suppression).

Visual Field

Visual field is "the extent of space visible to an eye as it fixates straight ahead" (Cassin 277). The visual field includes the area directly in front of the eye, as well as the peripheral vision. It is essential to the pilot to have a large visual field so as to encompass as much of the visual space as possible. In some cases, it is impossible to "watch your back" because the neck muscles cannot turn the head that far to the rear, or some structure of the air craft obstructs his or her view.

A pilot's visual field can be tested by a number of means. A fairly simple approach is with the Humphrey visual field test. In this test, the pilot must stare at a small light inside a large machine. A series of flashes will take place around the pilot's eyes, and he or she must press a buzzer every time the light is detected. The test is performed on each eye, and lasts between 15 to 20 minutes.

There are a number of problems a pilot may have if their visual field is reduced. One problem that may be present is tunnel vision. Tunnel vision is the "loss of [the] peripheral visual field with the retention of some degree of central field" (Cassin 271). Tunnel vision is commonly present at the end stages of glaucoma and retinitis pigmentosa. It is a condition that can lead to blindness at any time, and there is no cure.

Refractometry

Refractometry is "the measurement of refractive error" (Slatt 219). Good eye sight is a must for pilots because without it, they could not pass any of the visual tests. The pilot must have a clear picture of everything they view so that they can make accurate decisions. Poor eye sight does not necessarily disqualify a pilot from flying. Problems with vision can usually be corrected with corrective lenses.

Evaluating the eye sight is referred to as refraction. Refraction involves "[the] measurement of visual acuity, [the] measurement of accommodative ability, and the exercise of clinical judgement" (Slatt 220). Visual acuity refers to the ability of the pilot to distinguish small objects at the farthest distance possible. This allows a pilot to spot enemy air craft in times of battle. A pilot's accommodative ability is their ability to focus their eyes so that an image becomes clear. Pilots need to be able to focus quickly because the longer it takes them to see an object, the easier it is for the enemy to over take them. The doctor's clinical judgement is used to find the exact lens that will benefit the pilot the most based on the pilot's eyes, as well as their environment in the air craft.

The eyes are tested in a number of ways. The most common test is performed with the Snellen visual acuity chart. The pilot covers one eye and stands 20 feet from the chart. The pilot is then asked to read all the letters from left to right until the letters can no longer be read accurately. The ophthamalogist will then use an ophthalmoscope to examine the interior of the eye. With a retinoscope the doctor can determine the pilots refractive error. In some cases, the eyes will accommodate and prevent the doctor from getting an accurate evaluation of the refraction. In cases like this, the pupils are dilated. Dilation temporarily paralyzes the ciliary muscle, and prevents the eye from accommodating. The doctor can then more accurately tell if the pilot is myopic(nearsighted), or hyperopic (farsighted).

<u>Surface of the Eye</u>

The corneal surface of the eye plays a large part in the actual vision of the pilot. If the pilot has any scar tissue or abrasions to the eye, vision may be damaged in that spot. If their vision is depressed in any particular place, they do not have the entire picture of what lies in front and around them. Missing sight at any location of the eye can lead to many dangerous situations for the pilot and his air craft. Many people do not even realize they are missing part of their vision because of the overlapping of vision in the other eye.

The surface of the eye can be examined by Corneal Topography. The pilot sits in front of a large camera, keeping his or her eyes open. The camera flashes a bright light in the pilot's eye while it takes a picture of the cornea. Each eye is photographed separately. The machine then computes the curvature by mathematical analysis of the rings projected on the cornea. Any break or buildup in the surface of the eye is noted, and the computer then projects a colored picture of the corneal surface. The picture allows the doctor to see if the pilot has had any form of undocumented surgery, or injuries to the eye that may distort the pilot's vision. Pilots are not allowed to have any sort of surgery performed on their eyes that may cause scar tissue. Pilots that have any form of surgery that is not allowed by Air Force regulations are subject to being disqualified from aviation duties.

Conclusion

Eye sight is essential in the successful maneuvering of air craft. Therefore, vision is never sacrificed. There are those cases where pilots are given waivers to continue their flying, but they are few and far between. No one wants the people protecting their country to not be able to see the enemy. The government does not want to spend millions of dollars on air craft just to have it destroyed because the pilot had poor vision, plus even the pilot's own personal safety is in danger when they are put into a situation where their eye sight fails them.

Computers have yet to replace the need for exceptional eyes. Pilots are still expected to meet the eye standards set by the United States Air Force. Until technology can out do the eyes, pilots will continue to undergo eye exams so that only the "best of the best" survive.

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WHICH IS A BETTER SLEEP SCORING DEVICE FOR OPERATIONAL USE ? ACTIGRAPHS VS. LOGS

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WHICH IS A BETTER SLEEP SCORING DEVICE
FOR OPERATIONAL USE ? ACTIGRAPHS VS. LOGS

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Abstract

This study compared the activity monitoring device (actigraphs) with subjectively scored log sheets (logs) in terms of the information the techniques provide that would be useful to monitoring the sleep/wake cycles of operational Air Force personnel. It is important for investigators involved in assessing fatigue due to long duration missions or transmeridian travel to have a reliable technique that can accompany the crews. Subjects in the study were 10 healthy male and female laboratory personnel who participated during July of 1994. The study was conducted under more carefully described situations than could be done in the field in order to more accurately compare the two techniques.

The subjective logs and actigraphs were comparable in scoring time asleep and time awake during the 3 days study. The biggest difference between the two techniques was in average sleep times since the average log sleep time was about 8.5 hours per night and the average actigraph sleep time was about 6.25 hours per night. The logs recorded an average wake time of 17 hours and the actigraph of about 15 hours. Overall, the actigraphs had more variability across days which was taken to mean they were more sensitive to a greater range of sleep/wake times than the logs.

There are many similarities in the data collected by both techniques. For example, in measuring sleep onset, duration. However, the actigraphs had a resolution of about one minute whereas the logs resolution was about 30 minutes. The actigraphs were hampered by occasionally scoring daytime sedentary activities as sleep. However, this could be the algorithm used. The logs were weakened by being time consuming and subject to human memory errors. There are some data that is unique to each method. For example, the logs can record oral temperature and fatigue scores. The actigraphs are unique in the ability to record peak and trough activity periods unobtrusively.

The actigraph may offer the most important advantage in recording sleep/wake data in that it is objective where log entries are subjective. In addition, the logs are associated with a certain amount of human error that does not come into play with actigraphs. However, both techniques ultimately provides data that compliment each other and, if possible, both should be used in operational field research.

WHICH IS A BETTER SLEEP SCORING DEVICE FOR OPERATIONAL USE ? ACTIGRAPHS VS. LOGS

Jonathan S.Vinarskai

Introduction

The purpose of this investigation was to compare the subjective self report (in this case called the activity log or log) with the wrist worn activity monitoring device (actigraph) for assessing sleep/wake cycles of normal individuals. The long term goal of this research was to calibrate both techniques in a controlled study for further use as measures of sleep duration and quality in operational US Air Force personnel during field studies.

A number of studies have been conducted in normal subjects that compare self reports with actigraph data. For example, actigraphs were found to be better than self-report or physiological measures (heart rate and O2 uptake) because of their utility and accuracy (Patterson, et al., 1993). These authors performed reliability testing on the actigraph comparing physical activity (walking, running stair climbing, knee bends) with sedentary activity (reading, typing, video games, mental arithmetic task). Actigraph accurately differentiated within activity as well as between activities. Counts correlated with O2 uptake and heart rate during both kinds of activities. In another study, healthy people wore actigraphs for 5 days and the peak activity time was found to occur between 1330 and 1605 (Brown et al., 1990). Troughs of activity correlated well with their log sleep records. These authors concluded that the actigraph is a well-tolerated device to monitor sleep/wake cycles objectively and unobtrusively.

Actigraphs have also been useful in sleep labs for many years as a measure of sleep duration and perhaps as measures of sleep quality. For example, they were found to correlate highly with normal sleep (Brooks et al., 1993). These authors were successful in testing actigraph effectiveness during a sleep restriction treatment study in elderly insomniacs. They also, pointed out that logs were useful in getting the subject's perception of sleep duration which was often quite different from the more objective actigraph record. Another study reviewed techniques for monitoring sleep/wake in field research (Broughton, 1991). They used EKG, core body temperature, subjective reports and actigraphs to study naps and sleepiness in a non-laboratory settings. The current study sought to compare the self-report data collection method (logs) used by the Sustained Operations Branch at Armstrong Laboratory (CFTO) for the purpose of assisting field studies of fatigue in aircrew with actigraphs.

The growing use of actigraphs has led to the development of important improvements in their use and data evaluation techniques. For example, the leading methods measure sleep quality, the EEG, was correlated with actigraphic measures recently (Cole, et al., 1992). The authors validated methods they developed for EEG scoring on the actigraph. Their sleep/wake prediction algorithm was successful 88% of time in predicting sleep correctly. Sleep percentage and latency measures from actigraph were significantly correlated with polysomnogram records. Finally, automatic, computerized scoring of actigraph sleep/wake data is possible using algorithms available in a software package (GAAP; General Activity Analysis Program) developed for actigraph users (Ellsmore et al., 1993). For sleep lab studies, the Cole and Kripke algorithm is best but for field studies the more conservative Walter Reed algorithm is best (Ellsmore; personnel communique). Both algorithms are available on the GAAP software.

Methodology

In this experiment, ten subjects (six females and four males) the majority of them in their twenties were used. All subjects lived in the area of San Antonio, TX and were employees at Brooks Air Force Base. The data were collected during July of 1994 during the author's tenure as a summer research associate. Three criteria were used in subject selection: 1.) they had to be in good health, 2.) be normal sleepers, and 3.) could not be on any drugs that would affect their sleep. Subjects were all fellow employees who met the criteria. A free dinner at a popular restaurant was offered as reimbursement for their cooperation. In general they were very responsible in filling out the logs and wearing their actigraphs. With only a few notable exceptions: subject number 10_101 removed her actigraph five hours before the end of the study. That subject said that she took a shower and forgot to put it back on. Subjects 2_93 and 5_97 did not put their actigraph on until about 15 min after the 1200 start time. Otherwise, all subject cooperated fully.

Figure 1 shows the activity log given to each subject. Each log allows a record of 4 days in half-hour increments as shown. Subjects were asked to record activities in the 'Activity Code' row of each of the four 24 hour blocks using the code on the lower left of the sheet under the appropriate time the activity occurred. For example, a subject would score going to bed at 2200 hours (10 pm) on the first day by putting an S in the activity row in the cell under 22 (for 2200) on the first 24 hour block. About 30 minutes after the subjects awoke from sleep, they were asked to record how well they slept using the scale on the bottom of the log. The subjects were also asked to record their oral temperature every hour while awake and record it under the appropriate time in the temperature row. Subjects were asked to record their fatigue score using the scale on the bottom center of the log every time they recorded an oral temperature. All subject logs were checked on day 2 that they were completing the logs correctly. The forms and thermometer were designed to be easily carried and have been used for many years by the Sustained Operations Branch of Armstrong Laboratory at Brooks Air Force Base for operational use (for example, Boll et al., 1993). The data from the logs was entered by hand into spreadsheet form for subsequent computer analysis.

The actigraph is a small metal box that is worn like a watch. This device records the number of counts (the number of time a piezoelectric crystal sends off an electric pulse when moved on a 3 dimensional) on the internal random access memory or RAM. The actigraph can programmed to record counts on any time interval. For this experiment, actigraph were set to record the number of counts ever minute. First, activity counts were scored with the Cole and Kripke algorithm to determine the number of minutes per hour asleep and awake.

Figure 2 shows a typical recording from the small wrist-worn actigraph. The data in figure 2 represent wrist movements from one subject during the 4 days of the study. Each line of data is the record from one 24 hour period. It is clear upon inspection of these records where sleep/wake cycles are because they differ so dramatically in the amount of movement. For example, this subject went to bed at approximately 16 minutes after midnight and awoke about 0700 hours. The activity during a sleep period is conventionally taken to be an indication of how restfully an individual sleeps. Large amounts of activity would indicate a restless sleep due to the large amounts of tossing and turning. Figure 2 also shows the algorithm used to score sleep, in this case, the Cole and Kripke algorithm. The program developed by Ellsmore (1993) automatically scores the actigraph data and draws a darkened line under the times the algorithm would score sleep, as shown in Figure 2. The actigraph requires only that the subject take it off during showering or swimming (later versions are waterproof). Otherwise, no additional work is required of the subjects. Data can be compiled on sleep/wake cycles, sleep quality and perhaps awake activity intensity for about 14 days (later versions can record for about 30 days). The actigraphs are loaded into a device connected to a standard desktop computer and the information is machine scored in a few seconds. The scored minutes of sleep are available for every hour of data and the associated activity counts per hour. These data are easily transported into common spreadsheet programs for graphing and subsequent statistical analysis. During the analysis, actigraph scored sleep longer than 15 minutes in the 60 minute hour was scored as sleep or naps, depending on when it occurred, night time or day time, respectively.

FIGURE 1. The activity log used to collect subjectively recorded events.

TIME OF DAY (LOCAL)

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
ACTIVITY CODE																								
SUBJECTIVE FATIGUE																								
TEMPERATURE																								
ACTIVITY CODE																								
SUBJECTIVE FATIGUE																								
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SUBJECTIVE FATIGUE																								
TEMPERATURE																								

<u>ACTIVITY CODE/half hour</u>
Write in the proper code when appropriate.
S = SLEEP
A = AWAKE (TRYING TO SLEEP)
N = NAPS

PLEASE TAKE YOUR TEMPERATURE AT LEAST ONCE EVERY HOUR AWAKE.

<u>SUBJECTIVE FATIGUE</u> RECORD EVERY HOUR AWAKE
Write the number of the statement which describes how you feel RIGHT NOW.
1 = Fully alert, Wide Awake, Very Peppy
2 = Very lively, Responsive, Not at Peak
3 = Okay, Somewhat Fresh
4 = A Little Tired, Less Than Fresh
5 = Moderately Let Down
6 = Extremely Tired
7 = Completely Exhausted, Unable to function

UPON AWAKENING, INDICATE WITH
A + TO INDICATE THAT YOU SLEPT BETTER THAN NORMAL
A = TO INDICATE THAT YOU SLEPT ABOUT THE SAME AS NORMAL
A - TO INDICATE THAT YOU SLEPT WORSE THAN NORMAL

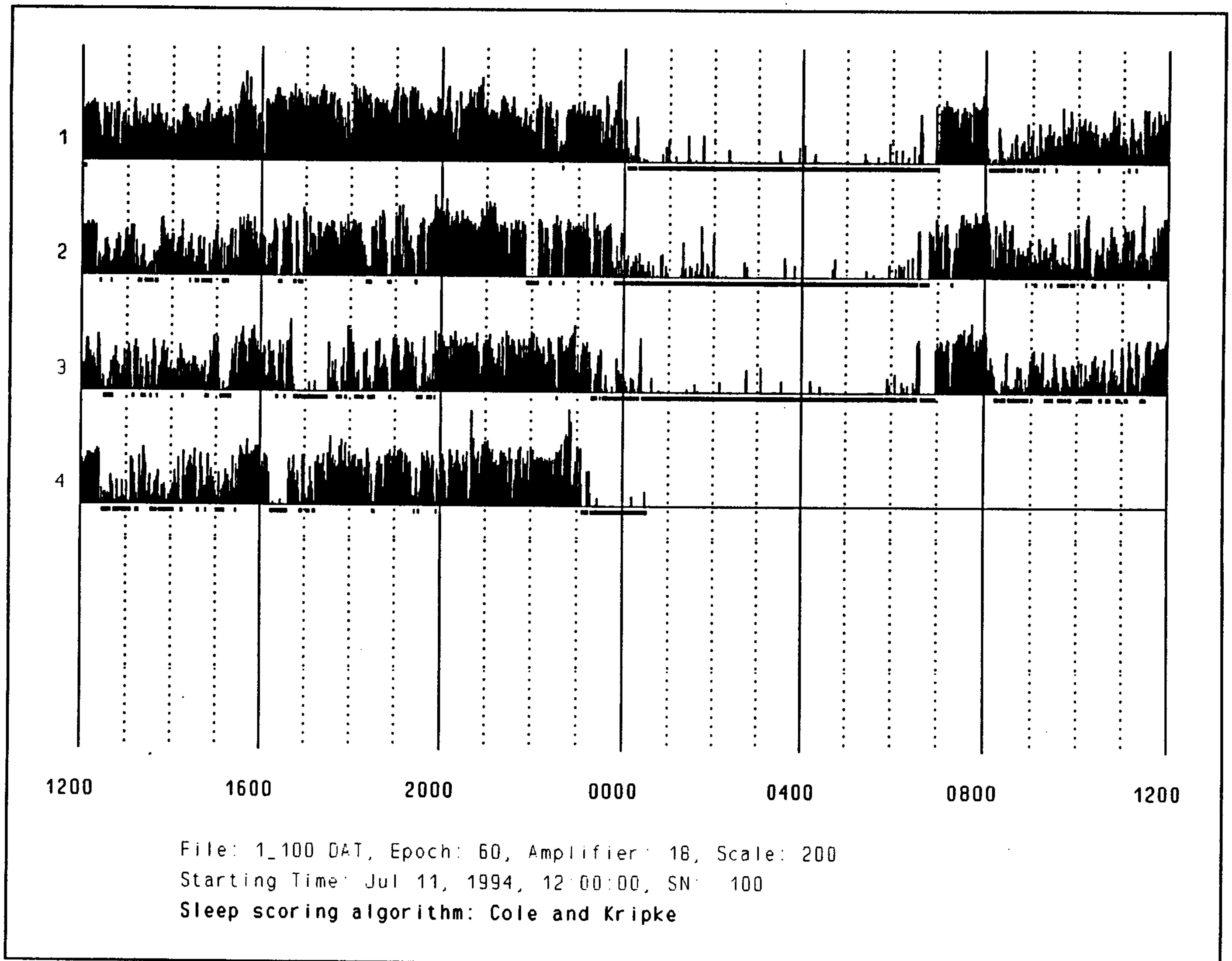


Figure 2. A four day record from the actigraph automatically scored by computer for sleep duration.

Results

Figure 3 shows that the actigraphs and the log are about equivalent with determining the hours slept per night. Closer inspection of Figure 3 suggests that the actigraphs may be more flexible in scoring hours slept. In each case, the actigraphs recorded more sleep and there was a wider range for actigraph scored sleep for example of about 8-9 hours per night compared to the logs record of about 6-6.5 hours. [Perhaps this is because the logs rely on personal memory]. The logs did not vary as much between days as the actigraph. The greatest resolution of the logs was 30 minutes because that is the time per cell on the logs. The actigraph resolution was set at 1 minute for the study but could be as low as 1 second (of course this would reduce the number of days available for recording). For all graphs, data are shown as mean score with standard error bars reflecting the dispersion about the mean.

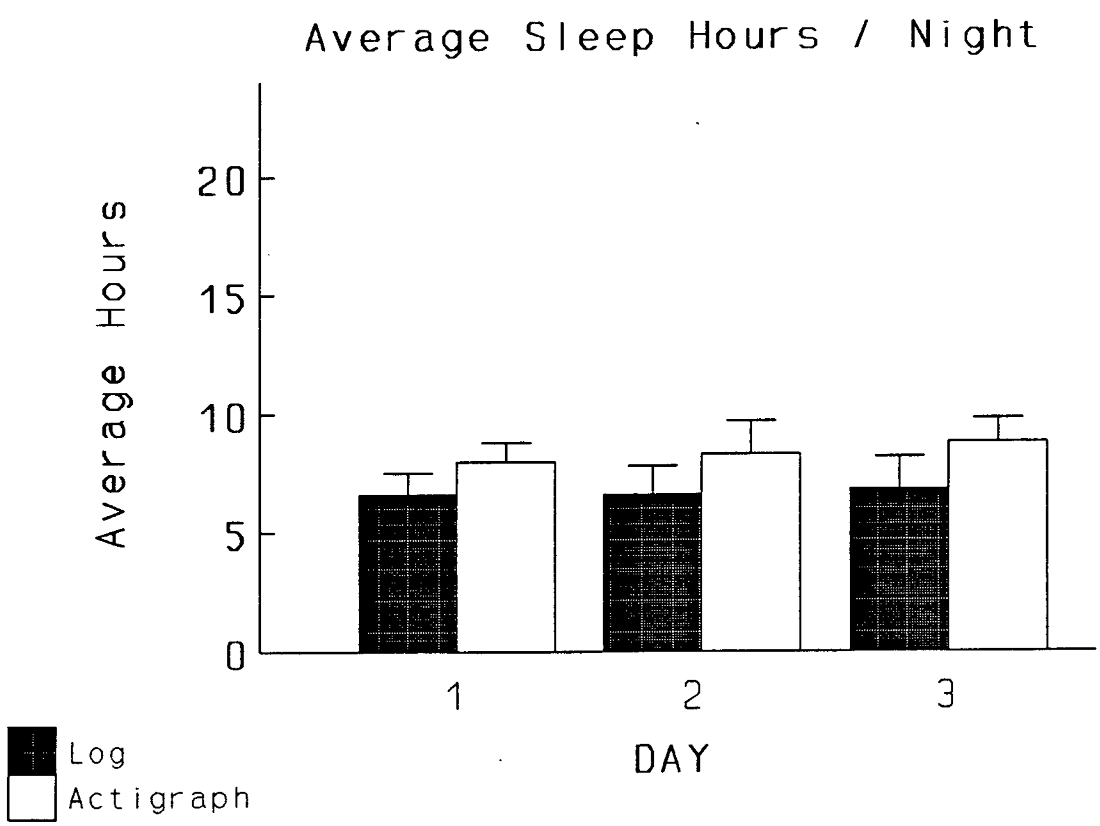


Figure 3. Comparison of actigraph and log data in amount of sleep per night.

Figure 4 shows that average hours awake per the three days of the study was slightly greater for the log data (about 17 hours) than for the actigraph data (about 15 hours). This is the reverse of the finding for average sleep data shown in Figure 3 above where the logs showed less sleep than the actigraphs. Again, however, the logs show less day to day variation. Overall, the logs and the actigraphs seem to be comparable in scoring hours awake.

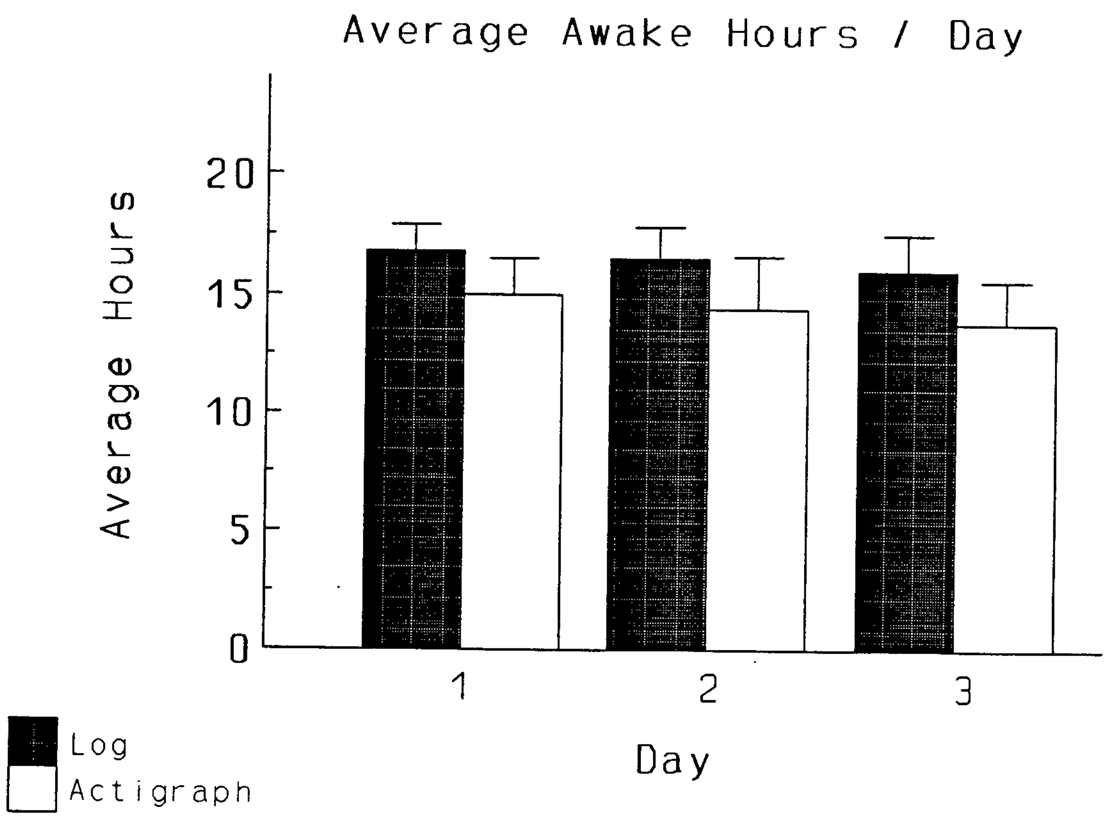


Figure 4. Comparison of actigraphs and logs in time recorded awake.

Figure 5 shows that the average time scored by the actigraph as napping was approximately 1 hour during the 3 days. During each day, the actigraph frequently recorded epochs of scored sleep according to the algorithm used. These may have been sedentary activity such as reading. Actigraph scored sleep of more than 15 minutes per 60 minute period was considered as too long to be sedentary activity and possibly as lapses into napping. However, on the logs, the subjects admitted to only an average of about 10 minutes of napping.

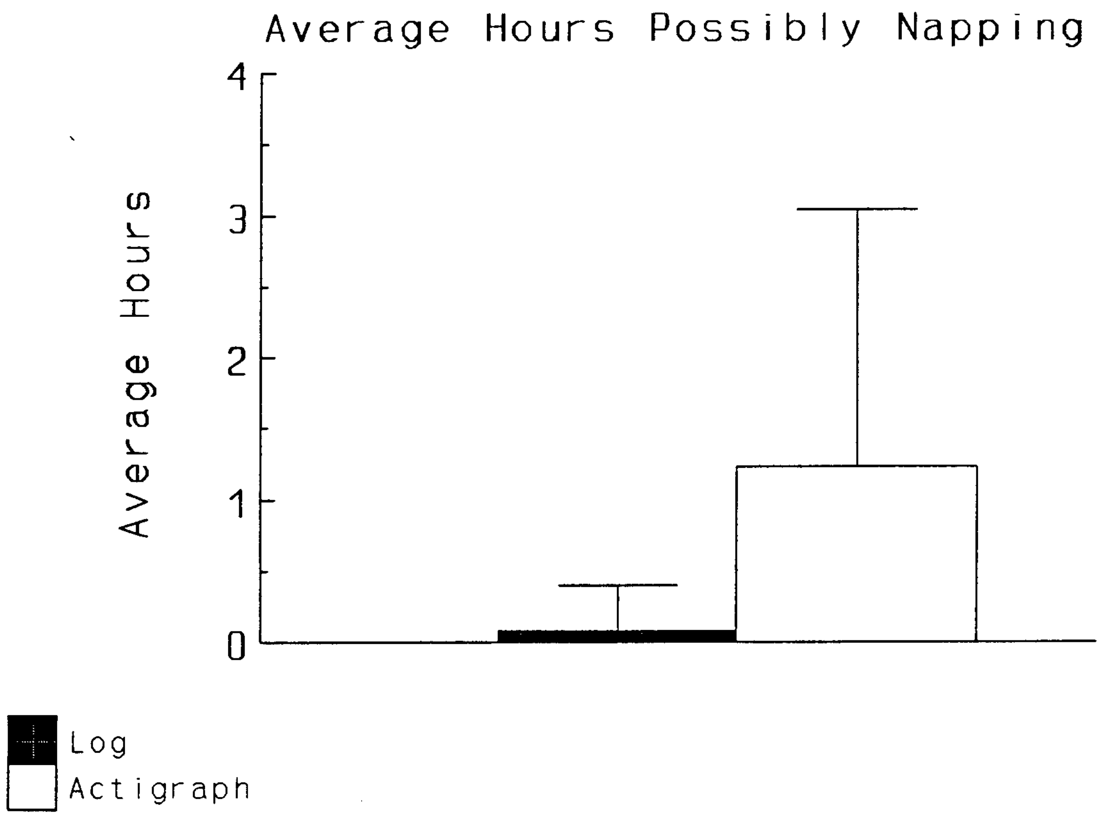


Figure 5. Comparison of actigraph possible naps and log recorded naps.

Figure 6 compares the actigraph indication of sleep quality (total activity counts per hour) with the log indicators of sleep quality. More counts per hour would be consistent with a poorer sleep and the data in figure 6 suggests that the highest counts are associated with the (-) or 'poorer than normal' sleep on the log. It is inconsistent though in that the log sleep quality indicator of normal sleep (=) is lower than that for better than normal sleep (+) in terms of actigraph counts.

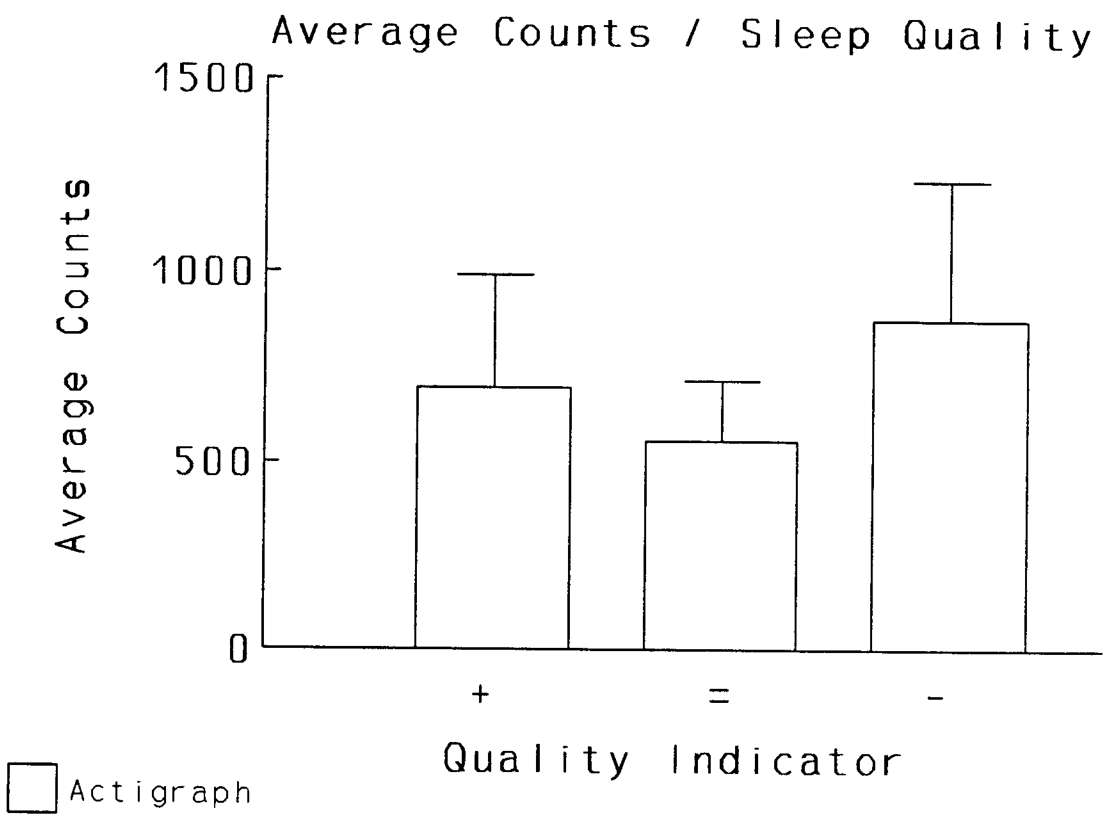


Figure 6. Actigraph counts compared to log sleep quality indicators.

Figure 7 compares the one measure of poorer (-), normal (=) or better (+) sleep quality on the logs with another, when the subjects reported being awake trying to sleep (ATS). There is good agreement between the poor and normal sleep quality in that more time was spent ATS than during better reported sleep.

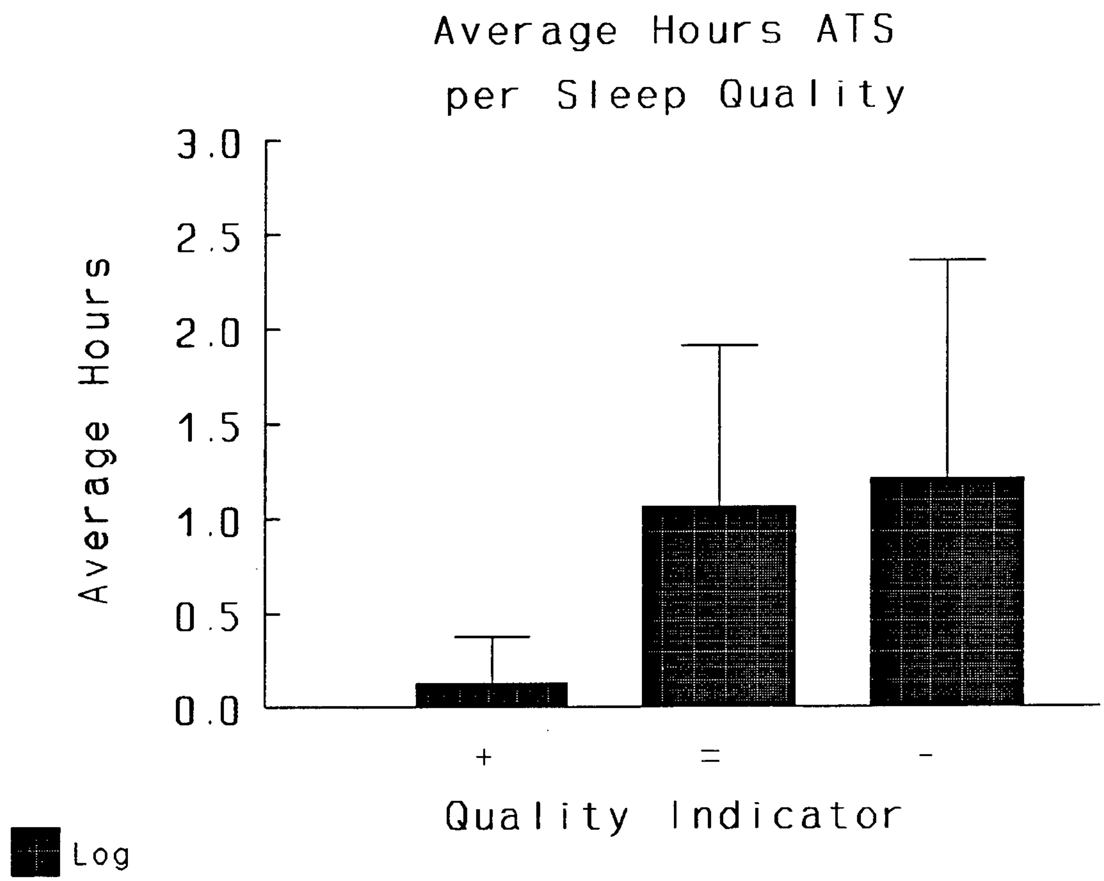


Figure 7. Log records of poor sleep (ATS) compared to log quality of sleep indicators.

Figure 8 represents an attempt to relate the fatigue scores recorded each time a temperature was taken with oral temperature. The figure shows that the lowest fatigue score (1) was associated with the highest temperature. The relationship does not seem to hold for other fatigue scores however.

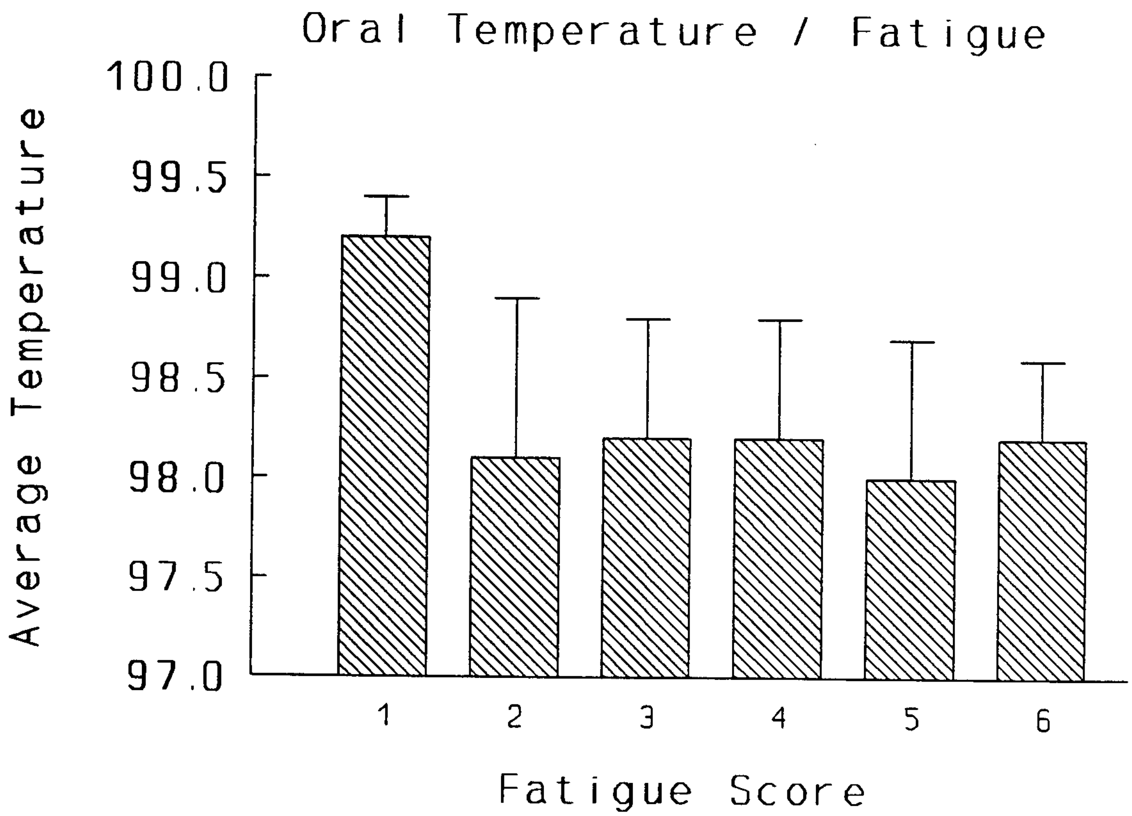
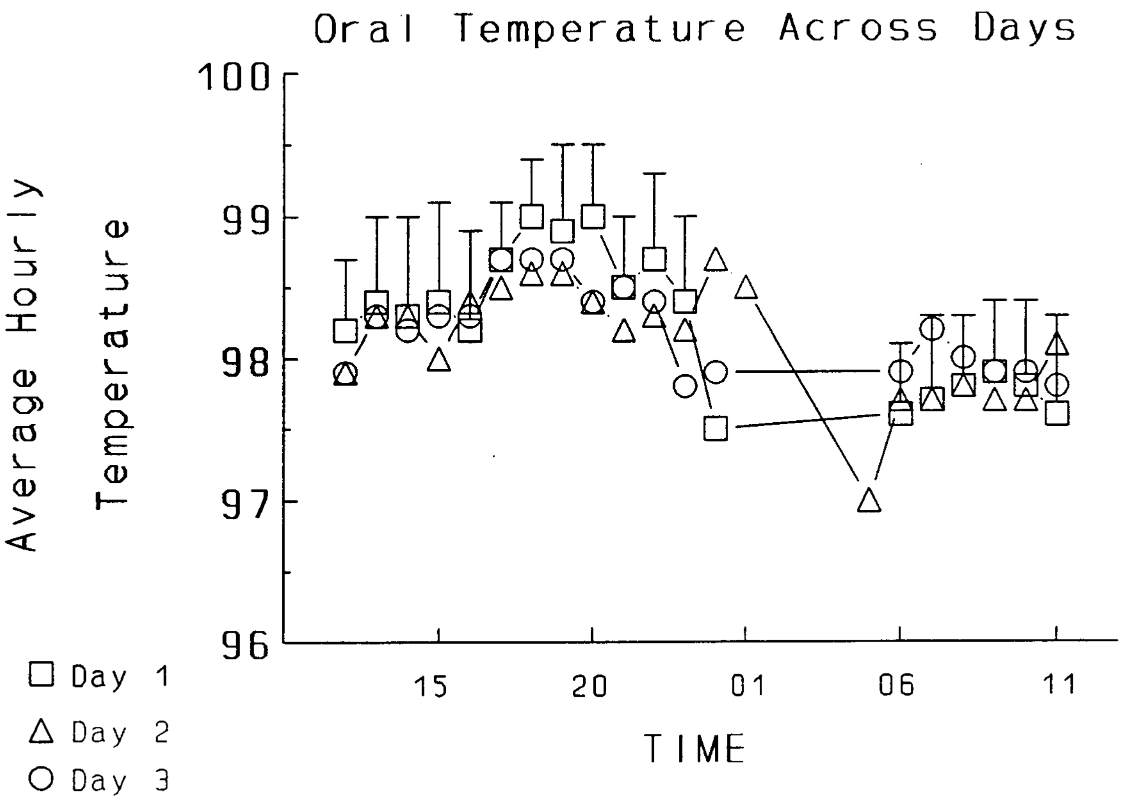


Figure 8. Comparison of oral temperature with log subjective fatigue scale.

Figure 9 indicates that oral temperature follows a circadian cycle and that the last 3 days of the cycle (in which a full 24 hour period could be recorded) were fairly consistent in the temperature variation. The peak temperature seemed to occur around 1800 daily. The lowest temperature was almost 12 hours later at 05-0600. The temperature at 0500 represents only 1 subject who was awake at that time. The temperature at 0600 is more representative of a number of subjects. It seems reasonable that lower temperatures still might be recorded if the subjects had not been sleeping.



The data in Table 1 indicate that the overall average oral temperature is about 98.2.

Table 1. Average of average hourly temperatures recorded while awake and Standard Deviation of the mean (SD).

Day 1	98.24	(0.16)
Day 2	98.16	(0.17)
Day 3	98.2	(0.27)

Conclusions

The study compared self-reports of sleep duration and quality with similar actigraph data. Oral temperature and subjective fatigue were also recorded throughout the day. Each technique offers both similar and unique information which are important for field use. The question in the title might be better posed to ask 'how do we best utilize the information in each rather than which is best for operational Air Force field use'. This study may have made some suggestions along those lines. Both techniques are about equivalent at seeing sleep hours per night (Figure 3). However, actigraphs seem to score more hours slept per night than logs and with more flexibility than log (logs were very consistent day by day). This may have to do with the greater resolution of the actigraphs at the settings used in the study.

Logs generally saw more hours awake during day (Figure 4) than the actigraphs and there was also less day to day variation in log data. Although, again, the logs and actigraphs were fairly comparable in scoring hours awake.

Although the actigraph is an objective way to score sleep during the sleep cycle, caution must be exercised in defining scored sleep while awake as nap (Figure 5). Actigraphs may have erroneously scored sedentary daytime activity as naps due to lack of activity (perhaps from reading). If the data do reflect unreported naps, the actigraph may have a valuable ability to identify napping. At this point, it can neither be confirmed nor denied.

The logs were definitely harder for the subjects to record their log data every half hour. By contrast, the actigraph records automatically. The logs were also harder for the investigator to score the data. By contrast the actigraph data can be automatically displayed in seconds and preparing the data for subsequent statistical analysis is simplified by the long streams of numbers.

Perhaps the actigraph is more sensitive to poor quality sleep (Figure 6) than to normal or better quality sleep. The higher counts associated with poorly rated sleep on the logs is an indication the actigraph may be sensitive to poor sleep. The log data for ATS may be a good indication of poor and good sleep quality (Figure 7) as more time was spent ATS during the former than the latter. A combination of techniques seems to be the best measure of rating quality of sleep.

A low fatigue score (1) was associated with the highest temperature values (Figure 8) but the relationship did not hold across fatigue scores. Perhaps the relationship between fatigue and temperature would be stronger if temperatures were taken later at night or very early in the morning when the subjects were more tired. Since no subjects reported the greatest fatigue score of 7 it is not possible to tell if temperature would be lowest for this extreme of fatigue. Some way of automatically recording temperature would be useful to record body temperature while asleep to compare with the actigraph log.

For many years, average oral temperature was reputed to be 98.6. These data were recently challenged and our data (Table 1) are more in keeping with the new average oral temperature value of 98.2.

The actigraph seems to be an acceptable measure by itself of sleep/wake cycles and some indication of sleep quality. The logs have always been considered acceptable measures but they may be too subjective to use by themselves and are demanding of the subjects (and the investigators) time. Both are good techniques but the logs seem stronger with the actigraphs than the actigraphs do with the logs. Perhaps temperature could be recorded every few hours rather than every hour to improve the time needed for the logs.

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THE EFFECTIVENESS OF HYPERBARIC OXYGEN THERAPY IN ENHANCED WOUND HEALING

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THE EFFECTIVENESS OF HYPERBARIC OXYGEN THERAPY IN ENHANCED WOUND HEALING

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ABSTRACT

The effectiveness of hyperbaric oxygen therapy in the treatment of soft tissue infections, crush injuries, thermal burns, and non-healing diabetic skin ulcers was studied. Enhanced wound healing is achieved through the pressurization of a patient at depths of forty-five feet below sea level or more while breathing pure oxygen at intermittent periods of time. This increases the amount of oxygen that is available to the blood and surrounding tissues, thus greatly increasing growth and diminishing the periods of time required for healing.

THE EFFECTIVENESS OF HYPERBARIC OXYGEN THERAPY IN ENHANCED WOUND HEALING

Zachary James Westbrook

Introduction

Hyperbaric oxygen was first suggested as a treatment for basic decompression sickness in the late 1930's--early 1940's. Dutch investigators later showed the potency of hyperbaric oxygenation in the treatment of gas gangrene. During the 1970's, hyperbaric oxygen therapy became the main source of treatment for all naval diving accidents. Hyperbaric oxygen has become more and more frequent in the treatment of many skin and tissue related wounds, such as soft-tissue infections, crush injuries, thermal burns, and non-healing diabetic skin ulcers.

Methodology

Patients were placed in "walk in" pressure chambers. These chambers pump air into the interior to create pressure equal to that of 45 feet below sea level. Once at "depth", the patients received intermittant administrations of 100% oxygen. These factors contribute to raise the arterial pressure of oxygen in the blood and tissues to nearly 1700 mmHg. When oxygen is inhaled under pressure, nearly 6.9 volumes percent of oxygen can be dissolved into the plasma.

Enhancement of healing is common during and after hyperbaric therapy in many non-healing and problem wounds. Hyperbaric oxygenation is also beneficial in the transportation of antibiotics throughout the body; therefore breaking down and destroying undesirable bacteria. White blood cell killing effectiveness is also greatly increased in atmospheres of high oxygen tensions.

Soft Tissue Infections

Hyperbaric oxygen therapy can be used as an aid to the treatment of soft tissue infections. Bacteria species require different oxygen needs. Hyperbaric oxygen therapy is a helpful adjunct in difficult life- or limb-threatening infections. The oxygen tensions in these infected tissues is low; increasing tissue oxygen tensions elevates white cell killing of the bacteria, inhibits anaerobic growth, and increases the potential of oxidationreduction.

Crush Injuries

Hyperbaric oxygen therapy must be induced at the earliest possible moment after the injury has occurred, with best results taking place within 4 to 6 hours after the injury. Hyperbaric oxygen therapy must be used in conjunction with standard surgical treatment.

Crush injuries involve damage to the bones,nerves,vascular areas, and soft tissues surrounding the wound, with ischemia and edema soon following. Edema of the tissues compromises blood supply to the wound. Hyperbaric oxygenation supplies plasma-dissolved oxygen to tissues and the wound area to enhance and support leukocyte killing, support tissue viability, and reduce edema.

Thermal Burns

The problems associated with the repair and healing of thermal burns are that they are infection-prone, leave extreme scarring, and take a great deal of time to heal. The problems are greatly elevated because of the lost integumentary barrier to prevent bacterial invasion, and the obstruction of microvasculation. This prevents cellular healing elements from reaching the damaged tissue and delays regeneration of tissues.

Animal studies have shown that hyperbaric oxygen therapy leads to a reduction in fluids required, improved microciculation, reduced edema, faster epithelialization, and a number of other positive benefits. These effects can be reached most efficiently if hyperbaric oxygenation is achieved within four hours of the initial accident.

Diabetic Ulcers

Diabetic skin ulcers are hypoxic wounds, and usually fail standard therapies and medical treatment. These ulcers have an average oxygen tension of less than 20 mmHg, and are greatly susceptible to bacterial infections. Raised oxygen tension, created by created by hyperbaric oxygenation, helps enhance leukocyte activity and promotes neovascularization. Hyperbaric oxygen therapy must be part of a coalition, along with intense medical treatments.

Complications

Common side effects of Hyperbaric oxygen therapyare sore ears. This is created by the pressure changes that the patients must endure, and some are not accustomed to this. It is a small problem that usually disappears within minutes. Patients with colds may suffer from sinus barotrauma, and should not be allowed to undergo hyperbaric oxygen therapy unless it is an extreme case or emergency. Another mild complication arises if a patient suffers from claustrophobia. Some patients have been found unable to withstand the two hours of restricted movement that is usually required for treatment.

Aside from these less-threatening, but common problems, there are some more dangerous complications; although they are rare. Pneumothorax is a rare hazard that only occurs in patients who are stricken with lung disease. Another rare, but serious complication is oxygen toxicity, affecting the nervous system. Neurotoxicity is caused by prolonged exposure to 100% oxygen at a depth greater than that of sea level, and it induces seizures. Fragile organs such as the lungs, brain, and eyes are also succeptable to damage.

Conclusion

Hyperbaric oxygen therapy is a growing field with more and more understanding being acquired each day. Hyperbaric oxygenation has been proven to be a helpful companion and adjunct to modern medical treatments of non-healing or problem wounds. When all safeguards and precautions are taken, hyperbaric oxygen therapy is a very valuable and successful form of medical treatment.

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UTILITY OF INTERNET BASED INFORMATION SYSTEMS IN AIR FORCE LABORATORIES

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Final Report for:
High School Apprentice Program
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Bolling Air Force Base, DC

and

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UTILITY OF INTERNET BASED INFORMATION SYSTEMS
IN AIR FORCE LABORATORIES

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Abstract

Applications of the Internet and their relevance to Air Force laboratories were investigated and their relative strengths and weaknesses were evaluated. Information for both those new to the Internet and experienced users was researched, and the Internet is explained in simple terms.

UTILITY OF INTERNET BASED INFORMATION SYSTEMS IN AIR FORCE LABORATORIES

Thomas E. Whalen

Introduction

The Internet, a rapidly growing collection of separate academic, governmental, and commercial networks, is a largely untapped information resource in the Department of Defense. As a source for program and resource information, as well as contact with other resources, its utility is unparalleled. However, the learning curve on the Internet is quite steep, and access to the technology is impaired by lack of exposure to current information retrieval techniques. Current Internet research techniques are essential to Department of Defense laboratories, as increased access and understanding of network information resources will ensure that the laboratories remain competitive and informed heading into the 21st century.

What is the Internet?

The Internet is an amorphous confluence of many networks, all of which share a common protocol suite, TCP/IP. TCP (Transmission Control Protocol) is responsible for breaking up data chunks into packets, sending them through the IP protocol, and reassembling received packets. The IP (Internet Protocol) is responsible for transmitting the packets of data through the network. IP is a connectionless protocol – each packet contains addressing information, which makes it deliverable independent from other packets.

Packets can take different routes through the network, and even arrive out of order. This means that when you 'connect' via telnet to an institution across the country, you are not actually 'connecting'.

How does it work?

Data sent from your home computer is broken up into packets, addressed, and dumped into the network, leaving it up to the routers, gateways, and other computers along the way to determine a route between you and the remote system. The remote system receives the packets and reassembles them into the data you sent out. This all happens very quickly, often in a matter of milliseconds, so it appears that your systems are actually 'linked' – which they are, but only in the most tenuous of manners.

Here is a routing trace of a transmission between a computer in Virginia and my office system:

```
traceroute to 129.48.130.1, 30 hops max, 40 byte packets
 1  garrett1-router.acc.Virginia.EDU (128.143.200.1)  1 ms  1 ms  2 ms
 2  gilmer-router.acc.Virginia.EDU (128.143.226.2)  2 ms  2 ms  2 ms
 3  sura-cisco-gw.ver.NET (137.54.200)  3 ms  4 ms  3 ms
 4  ctv-uva-c1.sura.net (192.221.3.13)  4 ms  8 ms  4 ms
 5  wtn8-ctv-c1.sura.net (128.167.139.1)  18 ms  38 ms  9 ms
 6  sura8-wtn8-c3.sura.net (128.167.212.1)  17 ms  21 ms  13 ms
 7  en-0.enss136.t3.nsf.net (192.221.252.248)  13 ms  20 ms  14 ms
 8  t3-0.cnss58.Washington-DC.t3.ans.net (140.222.58.1)  9 ms  9 ms  21 ms
 9  mf-0.cnss56.Washington-DC.t3.ans.net (140.222.56.222)  26 ms  22 ms  22 ms
10  t3-1.cnss72.Greensboro.t3.ans.net (140.222.72.2)  40 ms  24 ms  44 ms
11  t3-0.cnss104.Atlanta.t3.ans.net (140.222.104.1)  32 ms  31 ms  35 ms
12  t3-2.cnss64.Houston.t3.ans.net (140.222.64.3)  63 ms  63 ms  94 ms
13  t3-0.cnss112.Albuquerque.t3.ans.net (140.222.112.1)  84 ms  112 ms  85 ms
14  t3-0.enss172.t3.ans.net (140.222.172.1)  108 ms  103 ms  96 ms
15  129.238.28.8 (129.238.28.8)  116 ms * *
16  cewes-1.dren.net (138.18.190.1)  85 ms  77 ms  69 ms
17  arl-apg-1.dren.net (138.18.189.1)  100 ms  76 ms  72 ms
18  * wpafb.dren.net (138.18.187.2)  114 ms  121 ms
19  138.18.6.2 (138.18.6.2)  168 ms  162 ms  206 ms
20  * * 129.48.251.253 (129.48.251.253)  160 ms
21  router-29ae3.wan.wpafb.af.mil (129.48.47.249)  171 ms  160 ms  153 ms
22  129.48.130.1 (129.48.130.1)  160 ms  226 ms  214 ms
```

As can be seen, these three packets traveled a quite torturous route through the belly of the Internet to reach my computer. After leaving the university of Virginia around step 4, they went through Washington, DC in steps 8 and 9, Greensboro NC, in step 10, then through Atlanta, Houston, and Albuquerque, even though my computer is in Ohio. However long this journey seems, note that the packets arrived at my computer in, at most, 226 milliseconds. Not bad for a trip around the United States. It should be easy to see now that the Internet is a connectionless network.

You may have noticed that each node along the path had two names. One, the IP address, is numeric. The IP address is unique for each system on the Internet. The second is made up of words. Not all systems on the Internet have this type of address. These addresses are maintained by the individual networks each system is on. For instance, the system in Virginia from which the traceroute originated is named "hero.village.virginia.edu". This address is 'resolved' by a machine known as a Domain Name Server. These DNS machines turn hostnames into IP addresses.

What does this mean in terms of information? Well, since the Internet is a decentralized network, the information services on the network are also decentralized. That is, you are more likely to find that the information you are looking for on the Internet is distributed than you are to find it all in one place. The Internet is magnificently set up for client-server based applications, such as Gopher and the World Wide Web. (WWW) These applications of networking technology do not, in most cases, use huge centralized databases of information, but rather, collections of smaller, more specialized databases, linked together to form a broader information resource. Think of Gopher and WWW as standardized interfaces to query separate servers on the network.

As a part of the Department of Defense, you have access to one of the largest parts of the Internet, known as MILNET. Since MILNET split off from ARPANET, the original 'Internet' in 1984, it has still been a part of the global internet. Practically every unit in the Department of Defense is networked, and every unit is scheduled to be networked.

Why Network?

Every office in the DoD has something to gain by fully networking with the Internet. Whether the networking just simplifies electronic mail, or if the office sets up a Web server, the network will have profound applications in your office. Electronic mail and Usenet news will link you with legions of other researchers, scientists, engineers, and laymen who may be interested in your work. The vast, free, file archives make it easy to find software and documentation you might be able to use. Gopher and WWW can help scientists to find on-line sources of information and make contacts within their field. In this globally-competitive decade, and in the next century, knowledge is the key. To truly be successful in the scientific market, one has to have a well-defined idea of one's place in relation to everyone else. What is <u>your</u> office doing that a contractor couldn't? What is that contractor doing? Who is utilizing your results, and whose results should you be utilizing?

The beauty of the Internet is that in addition to being a great reference tool, it enables you to add to it. The Internet is growing exponentially, and the amount of information you can access on it is growing at the same rate. Placing your information on the net for others to access is like putting up a billboard – your message will reach a lot of people. And while you might not consider putting up a roadside advertisement for the research that you do, think of the researchers and engineers that may come across your information on the network and realize that you could help them, or that they could help you.

Getting Linked

Hooking up to the Internet is probably the most difficult part of using it. It's also the most difficult to write about, because setups differ so widely. But it's easy to say what the best methods of hooking up are for what you want to do. For instance, if you want to browse the WWW or if you plan to transfer large files, such as video, high-resolution graphics, or sound, you're probably going to want a direct connection. This means installing software on your system that will allow you to connect to the outside world through TCP/IP. Most UNIX workstations will have no problem doing this. However, with a system running Microsoft Windows or MS-DOS, outside software has to be brought in (although I've heard rumors of TCP/IP networking being included in the next version of Windows). The most important part of TCP/IP for Windows is the WINSOCK.DLL driver. This allows third-party software to interact with your network. As long as you can get a WINSOCK.DLL driver, and you have a direct network connection to the Internet, you can do about anything in Windows. For instance, most TCP/IP applications, such as telnet, network news, ftp, WWW, and gopher, are available free on the Internet. More about free software later.

If your computer is not on a network connected to the Internet, you'll have to look to outside sources to get your access. Surely, there are service providers in your area, most likely (if you are on one) on your base. Check with the nearest Technical Library, they're sure to know (Librarians are big on the Internet). There are myriad ways of getting connected, much too many for me to go into any great detail on in this paper. I'll leave getting connected up to your local authorities.

Network Applications

As of this writing, there is one great 'killer app' of the Internet world. This is NCSA Mosaic. Mosaic integrates telnet, ftp, USENET news, gopher, as well as advanced hypermedia. You'll appreciate it more after you've learned about the separate parts.

USENET news

USENET news is one of the older network applications. It is really like shared e-mail, or a discussion group. Messages posted in one part of the world make their way over to your neck of the woods and you can read and respond to them. This process is facilitated by the Network News Transport Protocol (NNTP), which is the way news servers (usually given a hostname of 'news', as in 'news.afit.af.mil') send articles to clients. The news is divided into newsgroups, usually on a certain topic. There are several news 'domains', such as 'sci' for science, and 'rec' for recreation. Newsgroups are designated in an easy to understand manner. For instance, the 'sci.aeronautics' group would be on the science of aeronautics, and the 'rec.arts.sf.writing' would be on writing science fiction. DoD has its own top-level news hierarchy, the 'dod' hierarchy. One interesting group is the 'dod.infosystems' group, which keeps up with current events in networked information in DoD. Other interesting groups might include the 'sci.military' group, and in fact all of the science hierarchy is useful.

One great thing about Usenet news is the FAQ list. A FAQ list is a list of Frequently-Asked-Questions, and their answers. Most newsgroups have at least one FAQ list. They are often posted regularly to the group, and often 'cross-posted' to the .answers group in the hierarchy. For instance, 'sci.answers' is full of answers to the most frequently asked questions in the sci hierarchy.

Some TCP/IP packages for Windows come with news readers, and some are available for FTP from sunsite.unc.edu in the /pub/micro/pc-stuff/ms-windows/apps directory. You'll find that in reading groups with heavy traffic, a 'threaded' news reader will work best. Threaded news readers arrange articles by subject, and you can follow reply 'threads' from one article to the next.

Telnet

Telnet is not so much an application as it is a protocol. Telnet (and its cousin 'rlogin') allow users to login to networked machines remotely. This means that from your desktop computer, or your workstation account, you can login to another machine halfway (or all the way) around the world. This might not seem useful if you don't have an account on a machine on the other side of the globe, but considering the number of things that you can telnet to besides workstation accounts, telnet is very useful.

For instance, by connecting to certain sites around the world, one can access on-line library catalogs, interactive conference systems, and often public-access information systems, like a public gopher client.

FTP

FTP stands for File Transfer Protocol. Again, it's not really an application, but more of a standard. FTP is one method you can use to move files from place to place on the Internet. The most common way to do this is through 'anonymous FTP'. This is where you FTP to a site, and login with a user name of 'anonymous', sending (usually) your e-mail address as a password. There are literally thousands of sites which accept anonymous FTP logins, and they offer millions of files for download. One such site was mentioned above, 'sunsite.unc.edu' which focuses on software for Sun Microsystems computers. Perhaps the most popular FTP site is 'wuarchive.wustl.edu', a general purpose archive, but with a large collection of MS-DOS and Microsoft Windows files.

FTP operates a lot like UNIX. To get your files, you'll be climbing up and down a directory 'tree'. Some FTP interfaces are graphical, drag-and-drop applications, while others are text-based. If your interface turns out to be text-based, here are some basic commands that should work:

<u>ls</u> - list files in the current directory
<u>cd [directory]</u> - change directory (UNIX uses the opposite slash from MS-DOS, so where you would type cd\, type cd / instead)
<u>get [file]</u> - gets a file. Be sure you are in the proper mode to transfer it.
<u>bin</u> - sets the FTP connection into binary mode to transfer binary files (files which aren't just ASCII)
<u>put [file]</u> - sends a file

Another FTP related tool is Archie, which searches a huge index for files available for FTP. If you were looking for a particular file, and you happened to know the name of it, you could use an Archie tool to find out where you could anonymous FTP it.

Gopher

Gopher is on its way out as an information resource, as many systems are converting over to WWW servers. However, a lot of information on the Internet is available on Gopher servers. Gopher is a distributed document delivery system. It's main purpose is to server text documents to clients. For instance, Wright-Patterson Air Force Base maintains a gopher server on 'ase20.wpafb.af.mil'. This server contains documents related to WPAFB and pointers to other WPAFB related services.

The most important Gopher server is located at 'gopher.micro.umn.edu'. This is the original Gopher server, as the Gopher system was developed at the University of Minnesota (mascot - the gopher). This server maintains links to just about every known Gopher server in the world.

A Gopher-related tool you might want to explore is Veronica. What Archie is to FTP, Veronica is to Gopher. Veronica searches a huge index for keywords you might want to find in a Gopher menu. If you're looking for something on Gopher, Veronica might be the quickest way to find it.

WWW

WWW is short for the Wide World Web. WWW is what you get when you take telnet, Gopher, FTP, and USENET News and link them all together under one common interface. WWW is again, a distributed system, and it's major client is NCSA Mosaic, developed at the National Center for Supercomputing Application at the University of Illinois, Urbana-Champaign. Mosaic is available for the Macintosh, for X-windows compatible UNIX systems, and for Microsoft Windows. The most current version of Mosaic is (at this point) not an official release. That is, it's not fully tested and all the bugs haven't been worked out. However, even in it's bug-ridden state, Mosaic is hands-down, the best application to browse the Internet. There are other browsers besides Mosaic, but since Mosaic is almost synonymous with WWW, there's really no reason to look into them.

Mosaic outperforms Gopher for several reasons. First, Gopher is made up of menus and documents, while the WWW operates with true hypertext, where everything is a document, but certain parts of a document can be links to other documents. This makes it easy to connect documents together, and to quickly browse the web. Also, Mosaic is capable of displaying graphics within text, something Gopher is incapable of. Mosaic also handles sound and full-motion video. Mosaic is also capable of browsing Gopher servers, FTP servers, and NNTP servers.

The only problem with Mosaic is that it requires a direct link to the Internet. Some of the files it transfers can be quite large, and it requires a certain amount of link and processor speed. Under the current version of Microsoft Windows (3.1), NCSA Mosaic requires some additional software. Since Mosaic is written to run under a 32-bit operating system, Windows needs to be upgraded to support 32-bit applications. This upgrade is available for FTP in the same place as Mosaic: 'ftp.ncsa.uiuc.edu'.

Good Web sites in the Air Force include 'http://www.hq.af.mil/' – the headquarters of the Air Force. Each of the laboratorys (except Armstrong) has a page:

Wright Laboratory: http://www.wl.wpafb.af.mil/

Rome Laboratory: http://www.rl.af.mil:8001/

Phillips Laboratory: http://plk.af.mil/

Another great Mosaic resource is the 'What's New Page' run by NCSA itself. This page (http://www.ncsa.uiuc.edu/SDG/Software/Mosaic/Docs/whats-new.html)is a list of most new servers on the Web. Whenever a new server is brought up, the administrator usually has it mentioned on this page, creating a really valuable resource. A searchable index to this page is available at 'http://cui_www.unige.ch/w3catalog'. This lets you query a database of every 'What's New' page, searching for topics that might interest you.

The DTIC Home Page is also a good resource for the laboratories. At 'http://asc.dtic.dla.mil:3221/', it contains links to lots of acquisition-related pages, and is also a good place to browse from. Defense-related research and development workers should definately look it over.

Conclusion

Because the Internet has such valuable information resources, it is invaluable for Air Force Laboratories as both a research tool and a means of communication. Laboratories ensure their future competitiveness by acting to promote the use of the Internet. By fully networking now, the Air Force will be in a good position for the next great leap in information technology.